ELECTRICAL REVIEW

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ELECTRICAL REVIEW

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6 JANUARY 1956

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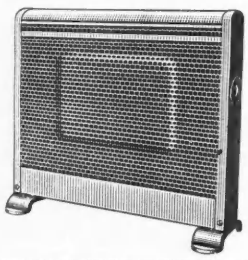

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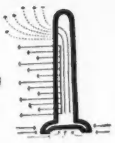

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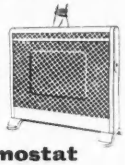

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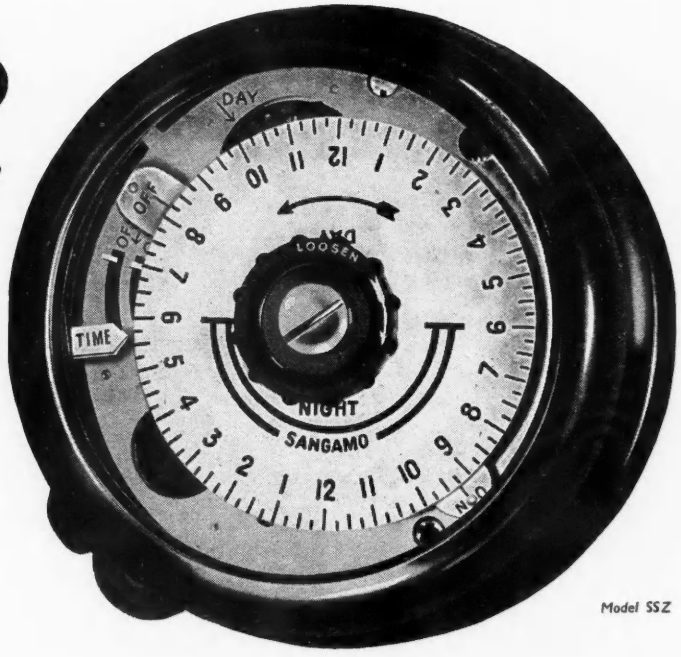

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ELECTRICAL REVIEW

6 January 1956 Vol. 158 No. 1 Established 1872

Electrical Prospect

LOOKING back at the past year those engaged in the electrical industry can generally feel satisfied at the results, although in some branches things could have been better. There has been no easing of conditions in overseas markets; indeed in some of them terms of trade have become more difficult. In spite of this our electrical export trade has continued to increase and there is little doubt that a new record was established in 1955.

At home electrical expansion, as measured by the sales of electricity by the Central Electricity Authority and Area Boards, has also continued at a satisfactory rate. Assessment of the nature of the expansion must await analysis of the figures, but the indications are that there was a slackening of the rate of domestic advance while industrial electrification went rapidly ahead. Stiffening of hire-purchase terms and, to a smaller extent, increased purchase tax were responsible for slowing down the domestic demand.

Throughout the year we recorded further achievements by British electrical manufacturers and more will be said about them in the customary annual reviews which we compile from information obtained from the leading companies. What is of even greater interest is the extent to which the foundations were laid for important future developments.

Possibly the most outstanding were the steps taken to ensure a sufficient supply of electric power in the face of the growing inadequacy of our coal supplies. The decision of the C.E.A. to burn oil in a number of its power stations may be regarded as a temporary measure, although no doubt it will have to be continued for a long time. Of greater significance was the White Paper on nuclear power published last February which announced the projected erection of twelve reactor power plants in a ten-year period. Already leadership in this new development had been secured by Great Britain by the erection of the Calder Hall plant which will be the first large-scale nuclear power station. Experience already gained and further knowledge to be derived from operation will give this country a lead which should prove valuable in the future.

Another development with great possibilities is the plan for modernizing British Railways at a cost of £1,200 million which the British Transport Commission published last January. This plan provides for an expenditure of £345 million on electrification and diesel traction and the first orders were placed last month.

These projects and such other achievements as the building of generating sets up to 200 MW, the construction of the 275 kV " supergrid," the manufacture and laying of the transatlantic telephone cable, and the evolution of automatic control systems will prove to the world the ability of British electrical manufacturers to meet all modern requirements and keep Great Britain in the forefront.

NUCLEAR ENERGY AND ELECTRICITY

In the report of the working party on nuclear energy of the O.E.E.C. referred to in this issue stress is laid on the possibility of nuclear energy being used more directly than is at present generally visualized, namely, after conversion first to heat energy and then to electrical energy. While our primary interest lies, of course, in the electrical aspect, we think it would be a mistake for the electrical industry to believe that the only way in which nuclear energy can be used is through the medium of electricity. Such a belief might lead to great trouble in the future. There seems to be something absurd in the idea of converting nuclear energy to heat and in turn to electrical energy and back again to heat for some of our present industrial applications. And yet it will certainly be found that for the widespread use of atomic power the electrical method of distribution is the most satisfactory. From another aspect, we may recall that at the U.N.I.P.E.D.E. Congress in London last September, Lord Citrine said that it was possible to contemplate the eventual use of radioactivity to produce electricity without heat conversion.

POWER RECTIFIERS

About 50 years ago the only method of converting a.c. to d.c. for industrial use was by using an a.c. motor to drive a d.c. generator. This led to the rotary convertor and subsequently to the higher efficiency motor convertor. Next, the mercury arc rectifier was produced with a higher efficiency than rotating convertors at medium and high d.c. voltages. More recently the contact rectifier made its appearance, setting a new standard by having an overall efficiency, including the transformer, of about 97 per cent. A formidable rival has now appeared in the shape of the germanium power rectifier, which combines the high efficiency of the contact rectifier with the static nature of the mercury arc rectifier and, in addition, is applicable over a wider range of voltages and kW ratings. For applications such as electro-plating the efficiency of the germanium rectifier is so much higher than that of any other type of equipment that it seems to be the obvious choice. For small d.c. supplies of from 1 kW to 100 kW efficiency is not so important, but the germanium rectifier is so much smaller than the alternative copper oxide and selenium rectifiers that it seems likely to be used extensively.

ENGINEERING WORKERS' DEMAND

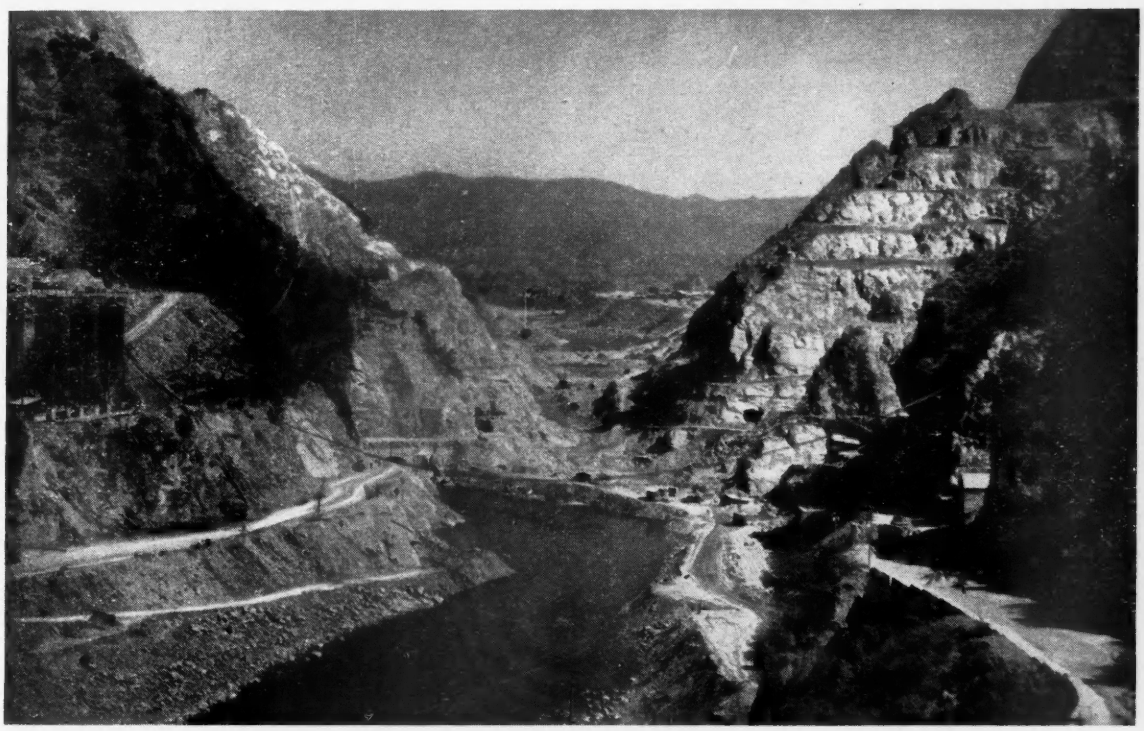
The trade unions representing workers in the engineering industry decided last week that the "substantial increase" in wages which they were demanding should be 15 per cent. In view of the danger of further inflation of costs which would seriously handicap engineering export trade, the claim was not received favourably by the Employers' Federation. Now the matter is being referred to the Federation's forty-six affiliated associations, whose views will be passed on to the unions at a meeting on 2nd February. Apart from the economic considerations, so large a claim seems to be unjustifiable. It is said that an increase of 10 per cent was originally envisaged; the pretext for the much greater demand is the alleged effect of the supplementary Budget upon the cost of living. Taken in conjunction with several other current applications for increased wages, this demand is ominous. Costs will make another upward move all round if any substantial part of the demand is met and the stage will be set for yet further calls for higher wages.

SMOKELESS FUEL

In our last issue we quoted from the speech of Mr. A. F. Oatley at the annual meeting of Cannon (Holdings), Ltd., in which he referred to the Coal Utilization Council as a Government-sponsored organization which was promoting the use of smokeless fuels which it knew to be difficult to obtain. Mr. J. S. Williams, director of the Council, in a letter in this issue, refutes the suggestion that the Council is Government sponsored and says that it recommends "the use of solid fuel, including coke and other smokeless fuels when available (and supplies are increasing) in modern appliances." While we gladly follow up our quotation with Mr. Williams's rebuttal our own contention remains unshaken: that it was wrong of the Government to raise the purchase tax on electrical (and gas) appliances instead of abolishing it as recommended by the Beaver Committee.

THE HONOURS LIST

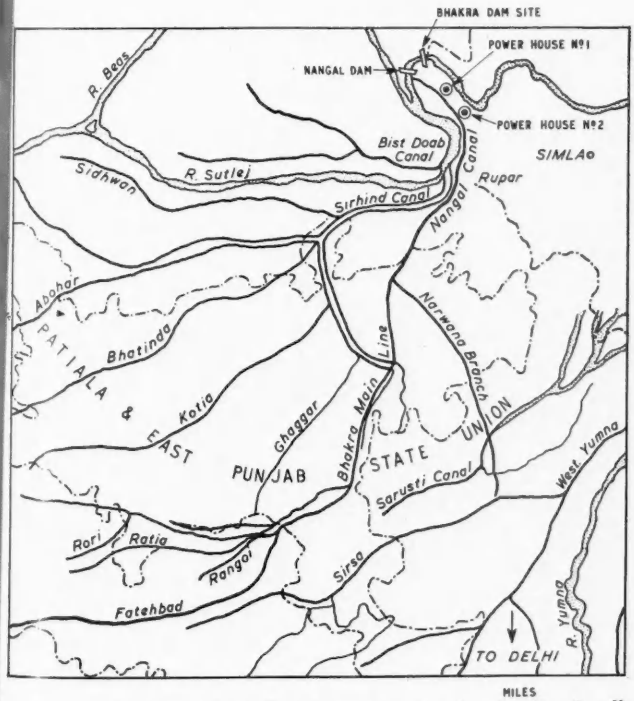
We again feel that the New Year Honours List does not take full account of the importance of the electrical profession and industry, but it contains some well-known electrical names. We are glad to see Sir Claude Gibb's work recognized by his appointment as a Knight Commander of the Order of the British Empire (K.B.E.). An interesting award is the Companionship of the Order of St. Michael and St. George (C.M.G.) which goes to Mr. E. R. Wilkinson, until recently commercial manager of the Central Electricity Authority, who recently spent a year in Mexico on behalf of the International Bank for Reconstruction and Development. Capt. C. F. Booth, assistant engineer-in-chief, G.P.O., is promoted to C.B.E., and new Officers of the Order of the British Empire include Messrs. C. W. Oatley, last session's chairman of the Radio Section of the Institution of Electrical Engineers, F. J. Cowlin (English Electric Co.), W. J. Huggett (G.E.C.), H. Weston (Belfast Corporation Electricity Department) and J. T. Byrne, who was the unsuccessful candidate for the general secretaryship of the Electrical Trades Union last year. The new Members of the Order include Messrs. A. Bowen (B.T.H. Co.), R. C. Butters (English Electric Co.), G. W. Essex (formerly of the Electrical Power Engineers' Association and now with the C.E.A.), G. Gunn (South of Scotland Electricity Board), R. H. Harral (North Western Electricity Board), W. R. Rose (G.E.C.), A. Ibbotson (Metropolitan-Vickers) and D. C. Rogers (Standard Telephones and Cables. Mr. W. C. M. Couch, deputy director of electrical engineering at the Admiralty, and Mr. W. J. Richards, director of radar research, Ministry of Supply, become Companions of the Order of the Bath. A number of people employed in various branches of the industry are awarded the B.E.M. To all those honoured we offer our congratulations.



The Bhakra gorge, looking upstream

BHAKRA NANGAL PROJECT

ASIA'S GREATEST HYDRO-ELECTRIC SCHEME



Area of the Bhakra Nangal project

IN the Punjab 200 miles from Delhi the first stages of the Bhakra Nangal hydro-electric and irrigation project have been completed and work on the biggest part of all, the Bhakra Dam, is now well under way. This scheme, which when ultimately completed will have a total capacity of more than 1,000 MW, will rank among the greatest in the world and certainly the largest in Asia.

In many parts of the Punjab in the areas of the Hissar and Rajasthan the ground water is 300ft below the natural surface, resulting in a chronic scarcity even of drinking water. The inauguration of an extensive irrigation system will bring new life to the area and make a drastic change to the lives of millions. In addition, power has been getting short in the area of New Delhi owing to the rapid rise in the load and the scheme should meet the increased demand for many years to come.

The suitability of the area for a large-scale hydro-electric scheme was realized by the British as early as 1908. The first project for a dam was suggested in 1919 and at intervals since then investigations have been made. In 1944 an extensive programme of exploratory drilling was started.

The scheme is based on the River Sutlej which flows down from the Himalayas and for some distance forms the boundary between India and Pakistan before joining the River Indus. The biggest part of the project is the Bhakra Dam, 680ft high, built of concrete and designed to form a lake of 7·4 million acre-ft capacity. Out of this, 5·7 million acre-ft will be usable and the regulated release of the water will irrigate about 6 million acres of

semi-arid land. Initially, a power station is being built on the left side of the dam and will contain six 100,000 kVA generators. It will be possible at a later date to incorporate an additional four generators of the same size on the right hand side.

From the Bhakra Dam water flows downstream for eight miles to the Nangal Dam, which is 90ft high and impounds 25,000 acre-ft on the Sutlej River. This is intended to even out the fluctuations due to varying release of water from the Bhakra turbines. Just above the Nangal Dam the Nangal-Hydel Canal leads off. This is a concrete-lined channel, 40 miles long, designed for a discharge of 12,500 cusecs, having a depth of just over 20ft and width at the top of 140ft. This drops through 100ft at each of the associated two power stations of Ganguwal and Kotla, each of which has three 24,000 kW generators.

In addition, a network of lined and unlined canals amounting to about 2,800 miles, including distributors, has been built from the neighbourhood of Bhakra to spread a normal flow of 12,500 cusecs over the area. The canal system was completed last year and inaugurated by Mr. Nehru on 8th July, 1954.

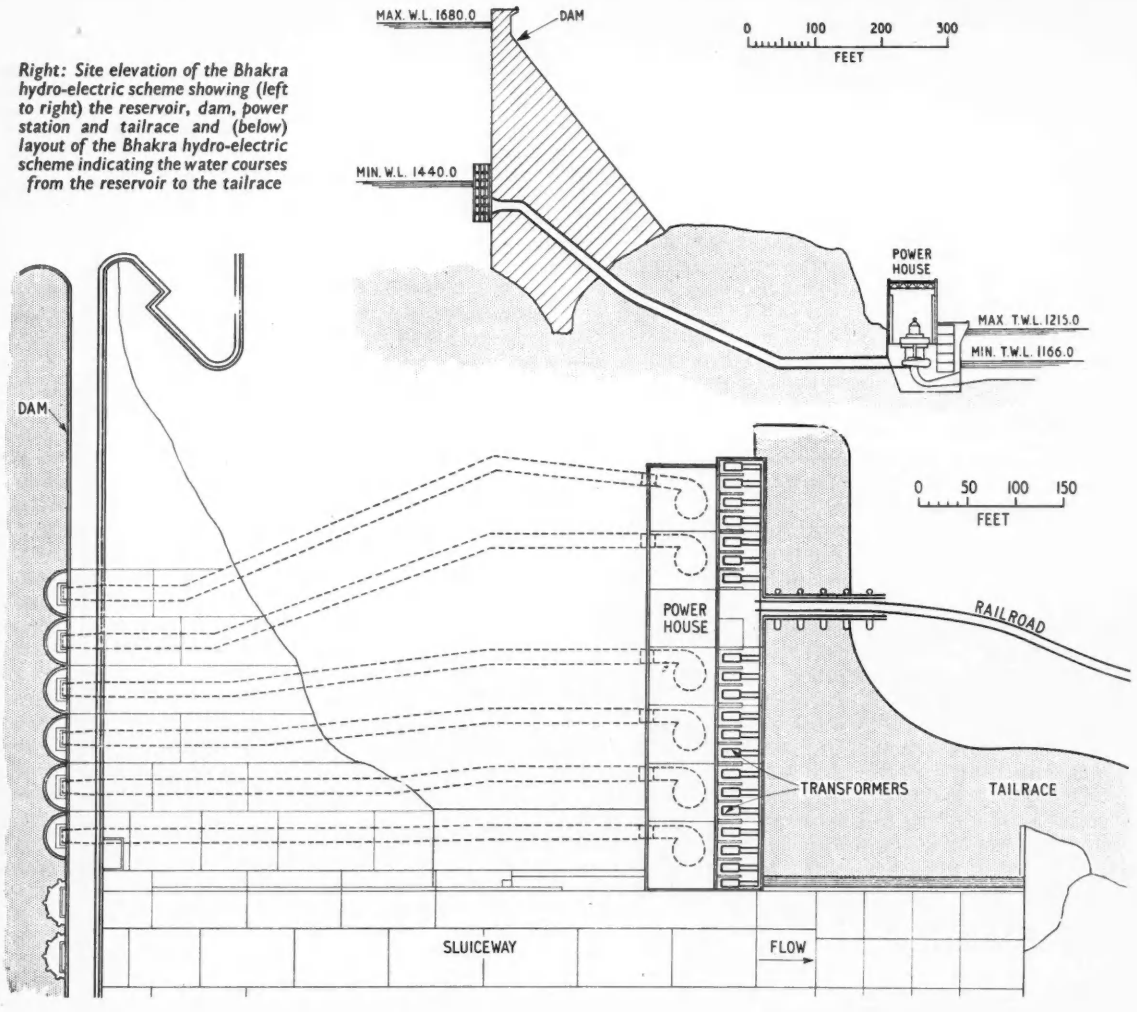
About 2,300 miles of transmission lines at voltages of 220, 132, 66 and 33 kV are being built to transmit power to all parts of the Punjab including Delhi.

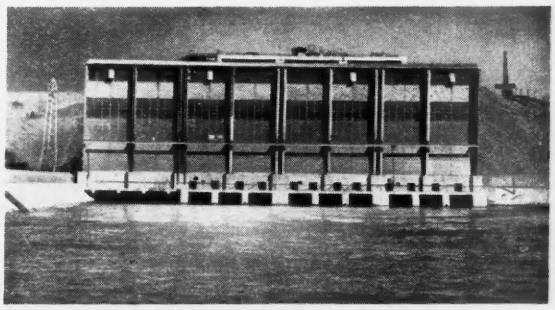
The Bhakra Dam and power station are scheduled to be completed by the end of 1959, at which time more than 5 million cu yd of concrete will have been placed. The dam site is situated in sandstone alternating with claystone strata in the bed rock. The claystones intervene in the sandstone horizons. The stratification is at about right-angles to the gorge, with some cross folding at higher elevations and the beds are tilted at an angle of 70 deg downstream. The dip is also not uniform but shows considerable variations near the zones where folding and thrust movements have taken place. The foundation conditions are further complicated by the presence of numerous isolated shear zones where crushing and sliding have weakened the material and made it friable.

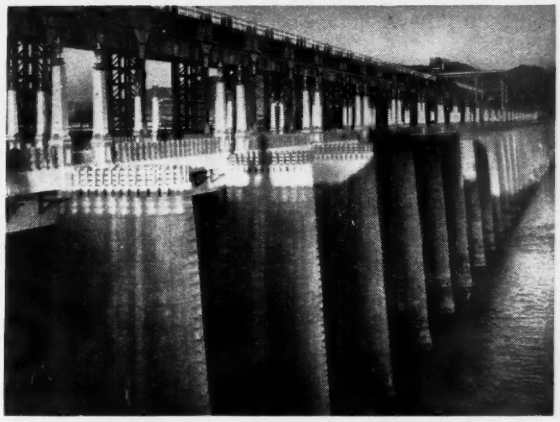
On top of all this, there are two zones in which claystone occurs for widths varying from 20ft to 100ft. The former is represented in what are called the "middle clays." These will be embedded under the body of the main dam. The other claystone member is on the upstream side above the heel of the dam called the heel claystone. It is felt that it will be adequate to trench out this claystone and back fill with concrete in the form of a plug to a depth of 75ft or more.

Discharge observations at the Bhakra Gorge since 1909 indicate a maximum flood of 390,000 cusecs. Routed in the big lake upstream of the dam, this will give a discharge of 290,000 cusecs at the dam, at top level. The disposal

Right: Site elevation of the Bhakra hydro-electric scheme showing (left to right) the reservoir, dam, power station and tailrace and (below) layout of the Bhakra hydro-electric scheme indicating the water courses from the reservoir to the tailrace







Above: Interior of Ganguwal station. Erection in progress on 24,000 kW unit. Above (right) Ganguwal station—completed exterior and (right) steel gantry housing the operating gear for the regulating gates of the Nangal dam

is mainly through an overflow spillway consisting of four spans each of 50ft, regulated by radial gates. The rest of the flood is to be passed through two tiers of river outlets each tier having ten 8ft diameter jet flow gates. The respective discharges which will be dealt with at the spillway and the outlets are 200,000 and 115,000 cusecs respectively, thus catering for the peak discharge although the incidence of such a flood has been computed as once in 1,000 years. The discharge through penstocks will be another 15,000 cusecs, which is a safety factor.

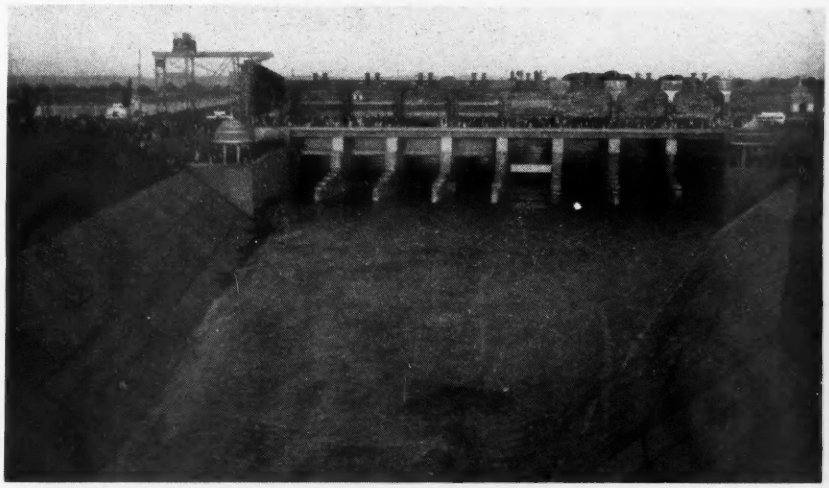
There are some 14,500ft of galleries provided within the body of the dam for access to the various points for drainage, grouting and operation of gates and hoists.

Because of the peculiar nature of the foundations, a comprehensive grouting programme has been worked out. Consolidation grouting of the entire foundation is first being done through holes 20-50ft deep. To reduce seepage and uplift deep curtain grouting will be done from the foundation galleries employing pressures up to 600 lb/sq in and holes up to 200ft deep. Stage grouting will be used in certain zones where during construction the overlying concrete is not of adequate depth to withstand the uplift caused by the grouting pressure.

The turbines being installed are of the vertical shaft single-runner Francis type with steel spiral casings, running on heads between 268 and 512ft, the average head being 370ft. The turbines are rated at 125,000 h.p. at 80 per cent of full gate opening at 400ft head. The operating speed is 166·7 r.p.m. The alternators have an output of 100,000 kVA at 0·9 lagging power factor and are each connected with a bank of three 33,333 kVA single-phase transformers. Generation is at 11 kV.

The Nangal power houses both of which are now almost finished, were initiated because several years ago it was felt that the power plants at the Bhakra Dam, needing about ten years for completion, were too much in the future for immediate power demands compared with the three or four years required to complete the smaller works. Use is made of a fall of 200ft between the Sutlej River at Nangal and at Rupar 40 miles downstream. These have been connected by the Nangal-Hydel Canal previously mentioned. This canal was the most difficult feature of the construc-

The head regulators at the start of the Nangal-Hydel canal



tional work involving many crossings over the numerous hill torrents of the terrain. The Ganguwal power station contains at present two vertical Kaplan turbines coupled to 24,000 kW 11 kV alternators. Provision has been made for the later installation of a third machine. The Kotla station has a similar arrangement. Connection between the two stations is by a double circuit 132 kV line. From Ganguwal a double circuit 220 kV transmission line goes to Delhi, the system having been designed to anticipate the later supply of power from Bhakra.

To speed the completion of the work the Punjab Government decided that manufacture of the spiral casings and penstocks should be carried out in their departmental workshops and purchased bending rolls to help with the work. This was the first time a spiral casing for a turbine as large as 33,500 h.p. had been designed and fabricated entirely in India.

Although it is likely that on completion of these various projects the available power will exceed the demand, there is every indication that India will be no exception to the experience of other countries that the load rises very rapidly on the availability of supply. Already new industries are springing up in the region and the Government has decided to build a large fertilizer factory at Nangal to manufacture nitrates by the electrolytic fixation of nitrogen from the air; heavy water will be produced as a by-product. This factory alone will have a demand of about 160 MW at a load factor of between 95 and 100 per cent. Thus the electricity produced will not only help development in the region but through the making of nitrates and the extensive irrigation of this potentially fertile country vast new reserves of agricultural production will be provided and the standard of living will rise.

The costs of the whole project are naturally very great. The Bhakra dam and power station are estimated to cost £50 million, the canal system £38 million, the Nangal dam, canal and power stations about £24 million and the transmission works £15 million.

RESUSCITATION AFTER SHOCK

The Rocking Stretcher Method

ATTENTION has previously been invited in these pages (*Electrical Review*, 27th May, 1955) to the accepted methods of artificial respiration, among which is the rocking stretcher method, first publicized by Dr. Eve, of Hull. This method appears to have gained considerable support in medical circles because, in addition to causing inspiration and expiration, it also promotes blood circulation. The method can be applied with little effort over prolonged periods if the patient is placed on a wide board in the Holger-Nielsen position and the board, resting on a trestle, is rocked ten or twelve times per minute and through an arc of 35 to 45 deg above and below the horizontal.

Application of the Holger-Nielsen method of resuscitation when a rocking stretcher is not immediately available

The application of this method in a factory should not present any difficulty because a suitably designed stretcher could be kept in the first-aid room and be available for use with little delay. In other places, however, time might be lost in finding the material for erecting an improvised stretcher, and it has been suggested that, under such conditions, artificial respiration should be started immediately, using the Holger-Nielsen method and then transferring the patient to the stretcher immediately this has been erected.

It appears, however, that in another country, training has been given in the application of the rocking method without a stretcher as a means of avoiding the above-mentioned delay. It also (and this is probably its primary function) permits the rocking method to be applied when the patient has to be carried from the place of shock to the place where the improvised stretcher has been erected. By kind permission of Faber & Faber, Ltd., the publishers of a book entitled "Artificial Respiration" by Dr. T. O. Garland, we are able to reproduce a photograph which shows how a patient may be carried forward while resuscitation by the rocking method is applied. Although this would seem to be a difficult thing to do and require training and co-ordination by the two men who are carrying the patient, it may be worthy of consideration.

Incidentally, it may be of interest that Dr. Garland, in his book, gives specific directions for carrying out the rocking action. He suggests a total arc of 90 deg and that a full up and down movement should take six seconds (i.e. ten complete rocks per minute). The six seconds should be divided as follows:—Two seconds at rest in the fully-down position; one second change-over to the fully-up position; two seconds at rest in the fully-up position; and one second change-over to the fully-down position.

It is further suggested that the change from up to down and *vice versa* should be by a sudden sharp jerk and not by smooth rhythmic motion, the purpose being to create pressure against the diaphragm to drive the air out and then to pull the diaphragm sharply down again to suck the air in.

Nuclear Energy in Europe

AN O.E.E.C. WORKING PARTY REPORT

UNDER the title of " Possibilities of Action in the Field of Nuclear Energy," a report prepared by a working party of the Council of the Organisation for European Economic Co-operation has recently been published. The working party (No. 10) consisted of Mr. Léandre Nicolaidis (Greece), the chairman; Mr. Roger Ockrent (Belgium); and Mr. W. Harphan (United Kingdom).

In June last the Council of the O.E.E.C. adopted a resolution agreeing to explore the possibility of economic and financial co-operation to serve the greatest benefits of member countries from the use of nuclear energy as a new factor in economic expansion. In the same resolution the working party responsible for the present report was instructed " to examine and report to the Council, as soon as possible, on the possible scope, form and methods of such co-operation." In the course of this study the working party of twelve member countries, including the United Kingdom, has been in touch with the permanent delegations of other countries. It also made preliminary contact at Geneva on 11th August with members of the United States and Canadian delegations to the International Conference on the Peaceful Uses of Atomic Energy, and since then it has been in touch with the United States and Canadian delegations to the O.E.E.C. and has been invited to continue discussions in Washington.

The report is divided into seven chapters in the first of which, " The Demand for Nuclear Energy," it is said that even those countries which still have large untapped sources of hydro power are, without exception, having to consider seriously how electric power production can continue to expand after all economically justified hydro installations have been put into service. This point will be reached within about ten years in France, Italy, Switzerland and Portugal, twenty years in Sweden and a little later in Norway and Austria.

In Europe, by far the greater part of all energy is consumed directly in the form of heat. Various member countries are planning to produce energy in the form of low temperature heat for industrial use (e.g. paper making) or for space heating. Metallurgical uses will probably emerge in the more distant future if the technical difficulties involved in generating heat at high temperature can be solved.

Production Costs

Although it may still be too early to calculate production costs for nuclear energy with any accuracy, it is believed that these costs are of an order of magnitude comparable with those of the conventional forms of energy; as the latter vary considerably from one region to another, it may well be that power produced from nuclear energy would already be economically advantageous in certain regions. It is generally thought that the cost of nuclear energy should fall in the coming years, and this would give this source an increasing importance in relation to conventional sources of energy. It would be a mistake, however, to expect these costs to fall low enough for nuclear energy to supersede other forms of energy.

Under " The Production of Nuclear Energy " it is said that " nuclear fuel " is a term which embraces two very different types, i.e. fissile and fertile. The " fissile " materials can be used directly to produce nuclear energy; they constitute the actual fuel for the reactor and, if sufficiently pure, the explosive for the A-type (atomic) bomb. Of the only three " fissile materials " which can be used in practice, uranium 235 is one of the constituents of natural uranium; plutonium and uranium 233 are materials which do not exist in the natural state but can be produced in reactors.

The " fertile " materials are " potential nuclear fuels " which, although incapable of emitting nuclear energy directly in a bomb or in a reactor, gradually undergo a partial transformation into the " fissile " type if introduced into a working reactor. Only two " fertile " substances are known to exist; uranium 238, by far the most plentiful constituent of natural uranium and thorium 232, the only constituent of natural thorium. In a reactor, uranium 238 is transformed into plutonium (Pu) and thorium 232 into uranium 233.

Uranium and Thorium Supplies

The first step to be taken by the country concerned is to prospect for natural uranium and thorium. This kind of prospecting is quite unlike any other, as it is based on detection of the radioactivity of the ores by special instruments designed for the purpose. This means that large-scale prospecting can be carried out by staff who are not geologists. The next stage is the actual mining.

Except in a few cases (Belgian Congo), the ore is found in very weak concentration (a few parts per 1,000) and therefore has to be concentrated either mechanically or chemically on leaving the mine. The high concentrates are not bulky and can be easily transported to a plant for chemical concentration to a high degree and conversion into oxides or other chemical compounds. Chemical compounds of natural uranium can be used immediately, as they contain fissile uranium 235. On the other hand, those of natural thorium (a fertile substance only) can only be used after treatment in a uranium reactor where the thorium is changed into U233.

The process most generally used is that in which the isotopes are separated by gaseous diffusion in a so-called " diffusion plant." The plant is fed with the natural product and it produces uranium from which U235 has been stripped (not usable at this stage) and uranium enriched in U235; the degree of enrichment can vary according to the design of the plant from a little over the natural proportion to almost pure U235.

Even without an isotope separation plant or uranium enriched in U235, the fissile content in a natural fuel can be increased. Natural uranium reactors are, in fact, convertors which produce plutonium and also a certain quantity of U233 if thorium is introduced.

The four great uranium producers of the world, apart from the countries of Eastern Europe, are: Canada, the Belgian Congo, the United States and the Union of South Africa. The next largest are probably Australia, France and the French Overseas Territories and Portugal. The potential large producers of thorium, a metal which will only become important later, are India, Brazil, and, to a lesser extent, certain French Overseas Territories (Madagascar).

There are several fundamental differences between a reactor and an ordinary boiler. A reactor requires a

minimum quantity of fissile material, which varies according to type: from 3 to 4 kg of highly enriched fuel in the case of certain research-type reactors, to hundreds of tons of natural uranium in the large reactors built at Calder Hall and Marcoule. The net consumption of nuclear fuel is extraordinarily low; a nuclear generating station with a capacity of 100,000 kW will "burn" only 150 kg of fissile material per year. But this fissile material is diluted with a large quantity of fertile material and, in addition, the fuel has to be renewed well before it has been completely consumed, as the mechanical properties of the "fuel elements" in a reactor deteriorate rapidly. However, the unused fissile and fertile substances are readily recovered by treating the irradiated fuel chemically. For these two reasons, the fuel consumption of such a reactor would amount to about a hundred tons per year. As long as the fuel is not "irradiated," the transport problem is easily solved; even when it has become radioactive, the transport facilities required, despite the cumbersome protective shells, are very considerably less than would be needed to handle conventional fuel—and this permits of considerable latitude in the choice of sites for nuclear power stations.

The development of a European nuclear energy industry requires a considerable effort as regards equipment, technicians and expenditure. So far, most of the effort has been made by two European countries: first, the United Kingdom, with its big nuclear research centre at Harwell and pilot installations at Calder Hall and Dounreay and, secondly, France, with the Saclay centre and the Marcoule pilot plant. Various other countries, such as those of Scandinavia, can already point to useful achievements. Nevertheless, Europe, taken as a whole, is very under-equipped as regards nuclear energy.

Prototype Reactors

The number of prototype power reactors under construction or in operation in the United States seems to be about twenty. In Europe, five or six power prototypes are probably being built, including three or four in the United Kingdom and two in France. Europe has no material-testing reactors in working order as yet. It is generally considered that the isotope separation plants for the enrichment of uranium set up in the United States, largely for military purposes, are at least ten times larger than the only European plant, which is in the United Kingdom. It has been stated that they consume as much electric power as the whole of France. It is also estimated that Europe's only large heavy water plant, which is in Norway, produces less than a twentieth of the United States' output.

It is considered that the co-operation which will develop within the O.E.E.C. should be applied as flexibly as possible. To this end, it will be advisable in particular to make use of Article 14 of the Convention which allows, in principle, for the conclusion of agreements between groups of countries, since a country which is not interested may refrain from taking part in a decision which is then only binding on the other member countries. The forms of co-operation proposed involve not only a variety of combinations between participating countries but also a variety in the representation of their national interests, which is left to their discretion—public institutions, mixed institutions or private institutions.

The report suggests the following broad outline of the organization which could best serve national and collective interests:—A Steering Committee for Nuclear Energy to be set up by the Council to secure, among other things, conformity of national programmes and the promotion of joint undertakings, training and standardization; a Control Bureau, responsible for security control of fissile materials; and Companies, to be set up as required, independent of the O.E.E.C., which will carry out joint projects concerning production and applied research. They would have independent management and would not be subordinate in any way to the Steering Committee for Nuclear Energy, but would establish relations with it for the mutual exchange of information.

To propose a formula for full co-operation would be to wreck the very idea of co-operation. On the other hand, the party would be rejecting the idea if it confined itself to marketing formulas. In the decisions which must be taken, member countries must not only be guided by their material interests but also by their political interests, without losing sight of the immediate and distant consequences of their choice and the real or potential sacrifices which it might imply. Studies concerning the promotion of a joint undertaking would be made at the request of two countries at least. They would bear in particular on the technical, legal and financial problems arising from the fact that such undertakings will be of interest to several countries. The expenditure incurred by the Organisation in respect of such studies would obviously have to be kept within reasonable limits since, once they were created, the joint undertakings would be the exclusive property of the parties which had provided the capital.

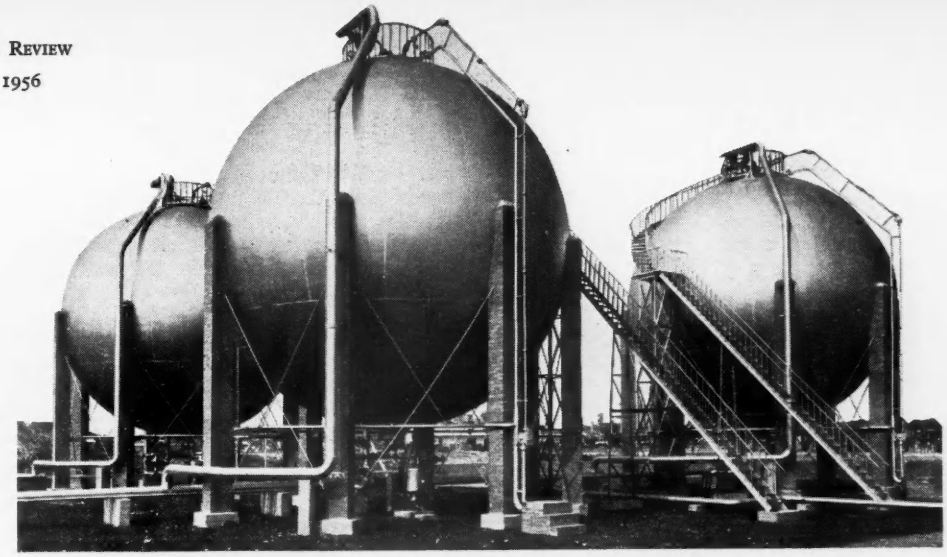
Co-operation in the matter of training is also most important. Lack of qualified labour seems at present to constitute one of the main bottlenecks in the development of nuclear energy for peaceful purposes, despite the efforts already made in this field.

It is proposed that promotion of training in the nuclear field should be organized by the following methods:—(*a*) Maximum use of existing facilities: to this end, it would be advisable to co-ordinate lectures and training courses, particularly those concerning the nuclear aspects of physics, chemistry and strength of materials. The exchange of teachers and students should also be encouraged. The experience gained by the European Productivity Agency might be used as regards the administration of this form of co-operation. (*b*) Creation of scholarships. (*c*) Creation, if necessary, of a European Centre for the teaching of nuclear science completing the training given in national centres. (*d*) Organization of training courses in some of the national or joint undertakings previously mentioned.

INTERNATIONAL TRANSFORMER SPECIFICATION

The International Electrotechnical Commission has issued "Recommendations for Power Transformers" (Publication No. 76), which is obtainable for 10 Swiss francs (16s 8d) from the Commission's central office at 39, Route de Malagnou, Geneva, Switzerland. The document supersedes the relevant part of the pre-war "I.E.C. Rules for Electrical Machinery." It covers auto-transformers but not transformers rated at less than 1 kVA single-phase and 5 kVA polyphase or those for instruments, static convertors, welding, starting, testing, or those for traction mounted on rolling stock.

It was circulated in draft under the I.E.C. "six months' rule," and was explicitly approved by thirteen national committees but not in entirety by those of the United States and Sweden. The most serious objection raised by the U.S. Committee relates to limits of temperature rise (by resistance methods) for Class A insulation. The recommendations specify 60 deg C for natural oil cooling and 65 deg C for forced-oil cooling, but these temperatures are regarded as too high for established practice and operating conditions in the U.S.A. The Swedish Committee considers that definite prescriptions should be included for ascertaining (whether by test or calculation) the ability of transformers to withstand short circuit.



Welded butane storage spheres at the Stanlow refinery of the Shell Refining & Marketing Co., Ltd. (Whessoe, Ltd.)

Metal-Arc Welding

A Survey of Future Trends

By W. I. PUMPHREY, M.Sc., Ph.D.*

IT is not possible to consider manual metal-arc welding and probable future developments in this field without considering first the tremendous strides that have been made in metal-arc welding since the first early experiments with bare wire electrodes and the later development of asbestos wound and plain extruded electrodes. The advances which have been made during the past few years in welding the hardenable steels, heat-resisting steels and aluminium alloys have revolutionized welding and constructional engineering practice and have made what was once impossible a practical reality. As some illustration of the progress which has been made in the development and application of welding during the past twenty-six years the following extract, taken from a description of the author's company published in 1929, is of interest:—

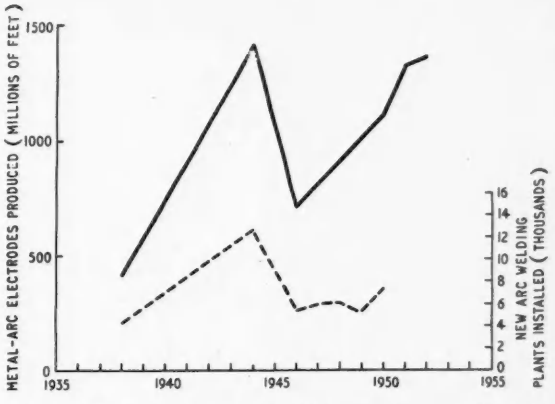
> "The company are continuously experimenting with new welding processes and have spent a considerable sum of money in carrying out research work in this direction. Although welding as an industry can still be said to be in its infancy, it is now recognized by discriminating engineers as being a process which will be widely adopted in almost every line of business in the future. Hardly a day goes by than a new use for welding is discovered, and to-day many small articles of domestic use are found to be welded."

With the present wide application of welding it is difficult to realize that this was, in fact, an accurate description of the welding industry only twenty-six years ago.

The continuing growth in the application of metal-arc welding is illustrated by the curves plotted in the diagram, which show the yearly consumption of metal-arc electrodes and the number of welding sets installed annually in this country since 1938. As the curves indicate, the yearly consumption of electrodes increased from 350 million feet in 1938 to 1,300 million feet in 1952 and approximately 7,000 new arc welding plants were installed in 1950. There is, as yet, no sign that the electrode consumption curve has reached its maximum and an example of what can be achieved by modern welding technology is illustrated in the photograph of three massive welded butane storage spheres at the Stanlow refinery of the Shell Refining & Marketing Co., Ltd.

One of the most noticeable features of the growth in the application of welding has been the tendency for the practical welding engineer and the metallurgist to collaborate in the investigation of any particularly troublesome welding problem. This close collaboration between the welder and the metallurgist over the past twenty years or so, and the great amount of research work that has been done in this time to establish the metallurgical principles involved in welding, has resulted in the development of a new technology and it is certain that any major developments in welding in the future will be a result of the continuing collaboration of the welder and the metallurgist. It is, in fact, most appropriate to consider the possible future developments in manual metal-arc welding on this basis.

In general, it can be said that the immediate future, at least, will witness the continuing growth of the use of metal-arc welding and the application of this process to



Output of metal-arc electrodes (full line) and welding sets (dotted) since 1938 (B.E.A.M.A.)

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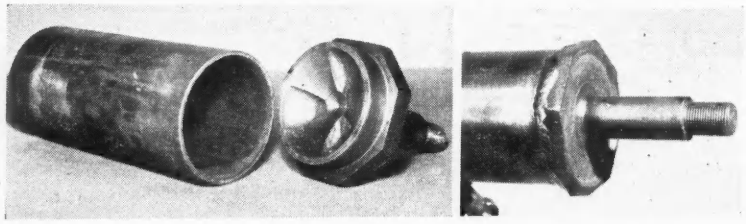
the construction of an ever increasing variety of ships, pressure vessels, containers and engineering structures. The increasing demand for flawless pressure vessels and chemical storage containers and the ever higher temperatures and pressures used in power generating installations will, of necessity, involve the development of electrodes of high standards of quality, and of appropriate welding techniques to ensure that the desired results are obtained in practice.

It is sometimes suggested that the inert-gas-shielded arc-welding processes will ultimately supplant the manual metal-arc process. While the application of the former type of process will undoubtedly increase, especially for the welding of non-ferrous alloys, the simplicity and many operational advantages of the metal-arc process will enable it to retain its popularity and increase its application in the foreseeable future. The fluxed electrode has the unique advantage over other welding devices that it is possible to convey into the weld pool, through the medium of the flux, desirable alloying elements which cannot be introduced into the weld in any other way. This advantage is of especial importance when it is necessary to counteract the ill effects which can attend the dilution of the weld metal by the parent metal.

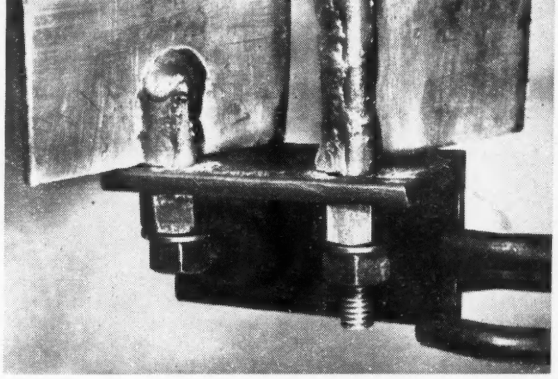
Mild Steel Welding

The successful development of mild steel electrodes containing a large proportion of rutile in the flux coating, some twenty-one years ago, was one of the most important developments in the metal-arc welding industry of this country. A number of the most successful of the early rutile electrodes are still used widely to-day and, indeed, it is difficult to foresee any major developments with this type of electrode in the near future although there may well be many minor modifications to the electrodes to improve their welding qualities. Future developments in the metal-arc welding of mild steel will undoubtedly be occasioned by the continuing demand for electrodes for the production of welds of ever increasing standards of soundness and homogeneity and by the demand for increased speeds of welding to improve productivity.



Left: The welding of a spheroidal graphite cast iron end piece to a mild steel tube

Below: Examples of mild steel rod welded to aluminium bar (van Someren)



The low hydrogen electrodes are already showing great promise as electrodes capable of giving welds of a consistently high standard of soundness. Careful attention to welding technique is necessary to achieve such results at present and the development of low hydrogen electrodes with improved welding characteristics can be anticipated with some certainty.

Any marked demand for increased speeds of welding and for improved deposition efficiencies will probably involve an extension of the use of electrodes containing a proportion of iron powder in the flux coating, although electrodes of this type have not so far become widely popular in Britain.

The present small but growing interest in steel storage vessels and structures designed to operate at temperatures below zero has already stimulated work on the development of electrodes which will deposit weld metal having good mechanical properties and, especially, good impact strength at such temperatures. This interest is likely to increase in the future and the electrodes so developed may also find application in the welding of structures destined to operate under conditions which are conducive to the occurrence of brittle fracture.

During recent years there has been a growing awareness of the economic and production advantages to be gained by the judicious employment of casting and welding as complementary processes. The full advantages of both processes are realized in the assembly, by welding, of a large and complicated structure from a number of smaller and simpler cast and rolled units. The improvement in steel casting techniques and the relatively recent development of the ductile, spheroidal graphite, cast irons will undoubtedly result in even greater developments in this field. A simple weld between a ductile cast iron end piece and a mild steel tube, made with an electrode based on a nickel-iron alloy core wire designed especially for welding spheroidal graphite cast iron, is illustrated.

Welding of Low Alloy Steels

When a metal is tested in tension at normal, atmospheric temperatures quite wide variations in the rate of loading produce no appreciable change in the value recorded for its ultimate tensile strength. At higher temperatures, however, a metal tends to deform plastically instead of elastically and, if sufficient time is allowed for gradual plastic flow to occur, metal stressed at a high temperature will break under a load which is considerably less than that corresponding to its ultimate tensile strength when this latter property is determined, at the same high temperature, with ordinary rates of loading. The gradual extension of a metal specimen or structure under a constant load applied at a high temperature is known as " creep " and the use of increasingly higher temperatures and pressures in power generating installations has caused the engineer and designer to become deeply conscious of the creep characteristics of metals.

The resistance of plain-carbon steels to creep may be increased considerably by the addition of suitable proportions of such elements as molybdenum alone, or nickel,

chromium, molybdenum—and often vanadium—in combination. Such steels are being used in some quantity at the present time and their use is likely to extend in the future. The electrodes which have been developed to weld the low alloy creep-resisting steels give weld metal containing such amounts of alloying elements as 0·5 per cent molybdenum, 1 per cent chromium with 1 per cent molybdenum and 0·25 per cent vanadium, and 2·25 per cent chromium with 1 per cent molybdenum. The most suitable electrodes for welding such steels are those of the low hydrogen type and the use of these electrodes for this purpose is certain to increase. The growing application of the low alloy creep-resisting steels may well make the attendant development of electrodes and welding technique one of the most important future developments in manual metal-arc welding.

Stainless and High Alloy Steels

The immediate future is likely to witness an increase in the use of the stainless steels and the high alloy heat-resisting and corrosion-resisting steels in the contruction of atomic power stations, oil refineries and chemical plants, with a consequent increase in the consumption of metal-arc electrodes for welding these materials, rather than any spectacular developments in the performance or application of the electrodes themselves.

The ferrite-controlled austenitic electrodes are now firmly established and their use will increase. With these electrodes the composition of the deposited weld metal is so controlled that the weld metal, while substantially austenitic, contains an appropriate proportion of ferrite. Wholly austenitic weld metal is susceptible to hot cracking and in welding the chromium/nickel stainless steels, experience has shown that the weld metal should contain an adequate proportion of ferrite (5 to 10 per cent) to prevent the occurrence of hot cracking, but not so much ferrite that the metal is unduly embrittled if it is maintained for any length of time in that range of temperatures (500 to 800 deg C) in which the ferrite islands in the austenitic matrix can transform to the hard and brittle sigma phase with a consequent deterioration in the impact resistance of the steel. The precise ferrite content required in the weld metal depends upon a variety of factors, such as the composition of the parent metal and the amount by which the weld metal is diluted by the parent metal during welding, as well as on the subsequent service conditions. It has been suggested[1] that the deliberate inclusion of a small quantity of ferrite in the weld metal to counteract hot cracking when welding the fully austenitic steels is unnecessary if the electrode core wire, while fully austenitic, is of a high standard of purity. Even if this suggestion is confirmed, however, it will be some time before the necessary core wire is available in quantity for the production of fully austenitic electrodes which will deposit weld metal with no susceptibility to hot cracking.

The increasing availability of low carbon 18/8 stainless steel core wire, with a carbon content of 0·04 per cent or less, will greatly facilitate the development of electrodes for depositing stainless steel weld metal of low carbon content. With such weld metal it is possible to effect a considerable reduction in the amount of the carbide stabilizing agent (most usually niobium) required in the weld metal to prevent the occurrence of weld decay occasioned by the intergranular precipitation of chromium rich carbides. Even with a weld metal containing 0·04 per cent carbon, however, it is necessary for the weld to contain a certain amount of niobium, if the heat treatment and subsequent service conditions of the welded structure are likely to be conducive to the occurrence of weld decay.

The welding of stainless steels to other metals, such as mild steel or copper, is likely to increase in the future for both economic and technical reasons and developments can be anticipated in the electrodes and welding technique used in such applications.

A good example of the importance of perfect welding is this end section of a reactor vessel for Calder Hall nuclear power station (Whessoe, Ltd.)

The complex nickel-molybdenum alloys containing, for example, 65 per cent nickel, 30 per cent molybdenum and 5 per cent iron which, at the present time, are more commonly used in America than in this country, have good resistance to corrosive attack by such media as sulphuric and hydrochloric acid over a wide range of service conditions. The wider application of such alloys by the chemical engineer could result in an increase in the quantity of electrodes at present used in Britain for welding these materials.

Copper Base Alloys

The majority of the copper base alloys are weldable by the metal-arc process although certain copper alloys require the adoption of a suitable welding technique if sound welds are to be produced. Thus, for example, it is not possible to use an electrode based on a brass core wire for metal-arc welding because of the unpleasant fumes and weld porosity which would be caused by volatilization of zinc from the core wire during welding. The brasses may be welded with electrodes based on either a tin-bronze or an aluminium-bronze core wire.

The tin-bronzes and silicon-bronzes may be welded with electrodes based on core wire of matching composition. These alloys are susceptible to hot cracking when welded under restraint and for the production of sound welds care should be taken to minimize the restraint on the joint during the welding operation.

The aluminium-bronzes have high tensile strengths combined with good resistance to corrosion and the duplex alloys may be heat treated in a manner similar to the hardenable steels. The alloys are readily weldable with suitable aluminium-bronze electrodes and the resulting welds are sound and strong.

The metal-arc process is used only to a relatively small extent for fabricating the copper base alloys at the present time and it is unlikely that there will be any immediate increase in the metal-arc welding of these alloys. There is a steadily increasing use of aluminium-bronze electrodes for the repair of porous areas in large castings, for the building-up and repair of marine propellers and the joining of extruded sections and rolled plates, and any increase in

the metal-arc welding of the copper base alloys is likely to be due to an increase in the use of this process with the aluminium-bronzes.

Aluminium and its Alloys

Gas welding of aluminium was being practised, successfully, in this country at the turn of the century and until recent years this process was the only one used on any notable scale for the fusion welding of aluminium and its alloys. The metal-arc welding of aluminium was long considered impracticable and even with the establishment of this process on a satisfactory basis some twenty years ago the resulting welded joints were not expected to be strong in comparison with the parent metal, except for welds in pure aluminium. Despite a somewhat slow start, there have been considerable developments in the metal-arc welding of aluminium and its alloys in this country during the past six years. Pure aluminium, aluminium-5 per cent silicon, aluminium-10 per cent silicon, aluminium-1¼ per cent manganese and aluminium-copper electrodes with good welding properties and easily removable slags are currently available, and although the present application of the metal-arc process for welding aluminium and its alloys is somewhat restricted it can be anticipated, with some confidence, that the process will be used to an increasing extent in the future, especially for the site welding of massive aluminium structures. It can be anticipated, too, that there will be improvements in the positional welding characteristics of the present electrodes and especially in the soundness of the resulting weld metal. Research work on this latter problem is, in fact, proceeding at the present time.

Weld dilution in metal-arc welds in H.10 material made with electrodes based on aluminium-5 per cent and aluminium-10 per cent silicon alloy core wires

Weld No.	Si content of Core Wire per cent	Gauge of Electrode	Type of Weld	Welding Current amp	Minimum Si Content of Weld Metal per cent	Dilution of Core Wire Alloy per cent
1	5	6	Butt, ⅛in gap, single layer	155	3·35	46
2	10	6	" " " " "	155	5·1	54
3	5	6	" " " " "	250	1·7	81
4	10	6	" " " " "	250	2·8	80
5	5	4	" " " " "	350	1·6	82
6	10	4	" " " " "	350	2·5	79
7	5	6	Gravity fillet " "	155	4·15	20
8	10	6	" " " "	155	6·6	37
9	10	4	Lap " "	350	3·95	66

One of the most interesting discoveries of recent years has been that of the high degree of dilution that can occur in metal-arc welds in aluminium alloys.[2, 3] The degree of dilution in welds in H.10 material (containing approximately 1 per cent silicon) made with electrodes based on aluminium-5 per cent silicon and aluminium-10 per cent silicon alloy core wires is indicated by the results recorded in the table. Such dilution is undesirable since it can promote weld cracking, and in an attempt to counteract the effects of weld metal dilution in the welding of H.10 material an aluminium-silicon electrode has recently been developed in this country based on an aluminium-10 per cent silicon alloy core wire and designed to effect the introduction of extra silicon into the weld metal through the medium of the flux coating. Tests made with this electrode have been most successful and the fluxing principle involved in the electrode may be more widely applied in the future.

Despite the many advances in recent years in the metal-arc welding of aluminium and its alloys no really satisfactory electrode has yet been developed for welding the aluminium-magnesium alloys, although aluminium-magnesium electrodes based on an aluminium-7 per cent magnesium alloy core wire are currently available. The maximum tensile strength that can be obtained with butt welds made with such electrodes in aluminium-magnesium alloy parent metal is of the order of 12-14 tons per square inch, a strength which is appreciably below that of butt welds made in the same parent material with the inert-gas-shielded arc-welding processes.

A certain amount of progress has been made towards an understanding of the factors involved in the successful development of aluminium-magnesium electrodes. The problem of porosity in aluminium-magnesium alloy weld metal is now adequately understood. The studies which have been made of weld metal dilution effects,[2, 3] and investigations of the loss of magnesium from the electrode core wire by oxidation and volatilization during metal-arc welding, have provided much useful data. The discovery, by the British Welding Research Association,[4, 5] of the harmful effect of minute percentages of sodium on the tensile properties of aluminium-magnesium alloy weld metal will also be of great assistance in the ultimate development of satisfactory aluminium-magnesium electrodes and the successful production of such electrodes can be anticipated in the not too distant future.

Until recently it was considered impossible to weld aluminium to steel by the metal-arc process because the melting points of the two metals are so different and because the flux which is necessary for welding aluminium is not suitable for welding steel. It has been discovered, however, that the welding of aluminium to steel may be achieved by cleaning the surface of the steel and coating it with a film of aluminium before welding.[6] After coating the steel, the joint may be made between the steel and the aluminium or aluminium alloy with the appropriate aluminium electrode.

An example of a mild steel rod welded to an aluminium bar is illustrated and the technique may find application in the future for such purposes as welding steel holding bolts to aluminium busbars or for welding steel studs to a prefabricated aluminium component or structure in order to join it to a steel framework.

General Conclusions

While the application of the inert-gas-shielded arc-welding processes will undoubtedly increase in the future, the simplicity and many operational advantages of the manual metal-arc process will enable it to retain its present popularity. The use of welding, and especially metal-arc welding, by the engineering and shipbuilding industries is certain to increase in the years ahead, and the research and development work which is now in progress will ensure that the present high standard of welding performance is maintained and that suitable electrodes are available for welding the new ferrous and non-ferrous alloys which become available to the engineer.

The author wishes to record his indebtedness to the directors of Murex Welding Processes, Ltd., for permission to publish this article.

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VIEWS on the NEWS

By REFLECTOR

ARTS and science are generally regarded by universities as entirely dissimilar if not incompatible. Yet it is most desirable if the engineer or scientist is to be a complete man that he shall have some cultural foundation. It is commendable on the part of Liverpool University that it has decided to encourage students who have reached a fairly high level on the arts side to read for an engineering degree. Writing on the general subject in the *Liverpool Daily Post*, Professor G. H. Rawcliffe, himself an Oxford M.A. and D.Sc. of Aberdeen, says that higher education exists both to keep alive the cultural values of the nation and to produce successive generations of professional men. It is often said that the student of arts or science has insufficient time to enable him to become acquainted with the other side. But Professor Rawcliffe, while admitting that to become a "real expert" needs all the time and devotion which can be given to one or two subjects, says that to acquire an educated man's reasonable familiarity with a group of subjects requires a great deal less time and is within the compass of a greater number of people.

* * *

I quote the following note from the *News Chronicle* because I feel that there must be a moral in it somewhere:—

"The roadsweepers of Edmonton complained that they could not keep up with their electrically-propelled dust-carts. So now the council have reduced the speed from four miles an hour to three and a half by having the carts fitted with smaller wheels. 'They make just that difference,' a spokesman said yesterday. 'The vehicles travel at a comfortable walking speed.'"

* * *

It is a well-known fact that when some mechanisms cease to work they can be restored to life, at least temporarily, by a sudden jolt. I know quite a few people who keep their radio sets running in this manner. Something of the kind goes on at Stotfold in Bedfordshire, where, as the *Star* informs me, the chairman of the Lighting Committee, referring to the village's sodium discharge lamps said: "Many of them are frequently out but if you give them a hefty kick they come on again." This form of street lighting control is to be deprecated and I am glad to learn that the Eastern Electricity Board is being asked to investigate.

* * *

A valuable contribution to the literature of electricity supply which I have just read is the 250-page story of the Sydney undertaking in Australia, written by Gordon F. Anderson. Although Tamworth was the first town in the country to have its streets lit by electricity (1888) it can be said that the inauguration of the Sydney undertaking on 8th July, 1904, marked the birth of electrical development in the Commonwealth on an appreciable scale. In its early years the undertaking had to weather many storms but electricity had some doughty champions. One such stalwart was the Town Clerk who, it is recorded

"flayed his critics as he attacked *ex parte* statements which he described as 'Ananias-like' in character. He quoted evidence that he had obtained from overseas to challenge and contradict the arguments against electricity. . . . He extolled its virtues and stated that some of its qualities were: purity, cleanliness, convenience, steadiness, beauty and safety. On each of these qualities he wrote at length. He had the cause of electricity at heart and the determination to confound the critics and convert the doubters."

Later, under the guidance of the late H. R. Forbes Mackay, city electrical engineer from 1908 and then general manager of the Sydney County Council until his retirement in 1938, the undertaking expanded rapidly. To-day it serves nearly 318,000 consumers and has an annual income of some £19 million.

* * *

Overhead line erectors in this country encounter enough trouble in the course of their work but at least they do not have to contend with the "little people" (unless there are still pixies in Cornwall). In Ireland this is an additional handicap, if a story in the Dublin *Evening Herald* is to be believed. Some Electricity Supply Board men were extending a line in County Wexford and found that one of the poles had to be set up in the middle of a large "fairy rath" (or ring) in a field.

"The men found that the pole in the rath gave them endless trouble, because no matter how firm they made the earth around it, the pole was found to be loose next morning. Finally they made the hole six feet deep and rammed home the earth so that nothing could shake it, as they thought, but next morning it was as loose as ever."

In the end (advised no doubt by a friendly leprechaun) they planted the pole outside the rath and it now stands as firm as a rock.

* * *

Purchase tax is (quite rightly) anathematized in the December issue of *Electron*, the official journal of the Electrical Trades Union. The tax is described as "the curse of the post-war period" in an indignant caption to an illustration of part of a catalogue showing prices and purchase tax additions. Naturally, one would expect the illustration to relate to electrical appliances. Nothing of the kind! The prices given are those of cars in the £1,162-£1,297 range.

* * *

Occasionally the radio listener hears "asides" which were not meant for the microphone. There is nothing new in this as an incident reported in the *Electrical Review* seventy years ago (1st January, 1886) serves to show:—

"The Palace of Locken is in telephonic communication with the Opera House in Brussels, and it appears that Her Majesty the Queen of the Belgians was the other day amusing herself by listening through the telephone to a rehearsal of the new opera by Litolff when she suddenly dropped the receiver and retired. The leader of the orchestra, in his anxiety to bring the chorus up to the degree of perfection he considered necessary, used rather strong language, forgetting for the moment that the telephone was present, and his words reached the Royal ears. The Queen made a formal complaint and now there is much trouble at the Opera House."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

At the annual general meeting of the Domestic Electric Cooker Section of the British Electrical & Allied Manufacturers' Association, held on 14th December, **Mr. E. G. Plucknett** (Simplex Electric Co., Ltd.) was re-elected chairman for the year 1955-56. **Mr. Ivor Williams** (General Electric Co., Ltd.) was elected deputy chairman, and **Mr. F. D. Felton** (Revo Electric Co., Ltd.) vice-chairman. These gentlemen will also serve in these capacities with the Associated Manufacturers of Domestic Electric Cookers (A.M.D.E.C.).

British National Electrics, Ltd., has appointed **Mr. E. L. Mercer,** B.Sc., A.M.I.Mech.E., as technical manager and **Mr. Ivor Martin,** N.R.D., M.S.I.A., as designer.

Mr. Mercer, who was educated at Manchester Grammar School and Manchester University, has served with Standard Telephones and Cables,

Mr. E. L. Mercer

Mr. I. Martin

Ltd., and with Armstrong-Siddeley Motors. He was with the General Electric Co., Ltd., for a number of years on domestic appliances and on radio, television and radar equipment.

Mr. Martin was educated in London and Plymouth, where he studied at the Central Arts School. For some time he was with the General Electric Co., Ltd., in its fittings design office, and then became a member of the research team of the Rover Co., Ltd. Recently he has been practising as a consulting designer in the Midlands, specializing in electrical products, and with the Belmos Co., Ltd., on switchgear design and development.

Mr. W. R. Jones, managing director of George Clark & North Eastern Marine (Sunderland), Ltd., has been appointed a director of the parent company, Richardsons, Westgarth & Co., Ltd.

The Minister of Fuel and Power has appointed **Mr. J. R. Rylands,** M.Sc., M.I.E.E., M.I.Mech.E., F.Inst.F., J.P., of Wakefield, and **Councillor G. C. Hurst,** of Thorne, Doncaster, as members of the Yorkshire Electricity Consultative Council. **Mr. F. V. Brook,** of Huddersfield, **Councillor W. G. Pallett,** J.P., F.C.W.A., of Sheffield, and **Mr. R. A. D. Warren,** B.A., of Steeton, nr. Keighley, have ceased to be members of the Council.

The South of Scotland Electricity Board has appointed **Mr. Ronald Lott,** A.M.I.E.E., A.M.Inst.F., to be station superintendent at Portobello generating station. Between 1941 and 1948 Mr. Lott was with the South Wales Electric Power Co. and from 1948 to 1954 with the South East Scotland Division of the Central Electricity Authority, latterly as senior assistant engineer (generation/operation). In 1954 he was appointed deputy station superintendent of Dunston "A" and "B" and Blaydon generating stations.

Mr. R. Lott

Mr. W. T. O'Dea, B.Sc.Tech., M.I.E.E., Keeper of the Department of Aeronautics and Sailing Ships in the Science Museum, South Kensington, has been released for three months to undertake a mission for Unesco. He will advise the Ceylon Government on establishing a science museum at Colombo, and at New Delhi will discuss proposals for four others in India.

Mr. A. D. Smith has resigned as a director of Radio Rentals, Ltd. **Mr. P. Perring-Thoms,** the chairman, will in future act also as sole managing director.

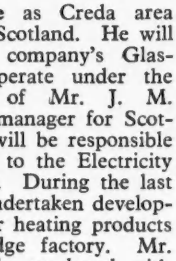
Mr. R. E. A. Claessens has been appointed general export manager of E. K. Cole, Ltd. He will be responsible to Mr. W. M. York, executive director, and will co-ordinate Ekco export activities covering radio, television, plastics and "Thermovent" heating equipment. Before joining E. K. Cole, Ltd., Mr. Claessens was sales and administration manager of a subsidiary company of Murphy Radio, Ltd.

Mr. R. E. A. Claessens

Mr. F. B. Howard-White has been appointed a member of the Mond delegate board with effect from 21st December. Mr. Howard-White was educated at St. Paul's School and took honours in the Mechanical Sciences Tripos at Cambridge. He served in the Royal Engineers in the 1914-18 war, was mentioned in despatches on three occasions and was awarded the M.C. He was called to the Bar in 1928 and in 1938 was appointed joint secretary of the company. In 1951 he became a director of Birlec, Ltd., relinquishing that appointment when the company ceased to form part of the Mond organization. In May of this year he was appointed director of Henry Wiggin & Co., Ltd. He is a Liveryman of the Worshipful Company of Goldsmiths and a Freeman of the City of London.

Mr. R. W. Hayward, A.M.I.E.E., senior branch manager of Cantie Switches, Ltd., relinquished his appointment on 31st December to practise on his own account as an engineering consultant. Mr. Hayward had been closely connected with the company's expansion during the post-war period and of recent years had been manager for the London and Home Counties area. He is succeeded as manager for London and the Home Counties by **Mr. F. Nye,** hitherto deputy London manager, and specialist in marine electrical distribution problems. With his new appointment Mr. Nye will continue to have specialist responsibilities in the application of Cantie "Minunit" cubicle-type switchgear to the marine field.

Mr. K. B. Strong has been appointed accessories sales engineer, London area, of the Simplex Electric Co., Ltd. Mr. Strong was previously with Arrow Electric Switches and Brown Bros. He relinquished his post with James Booth & Co. to take up his present position.



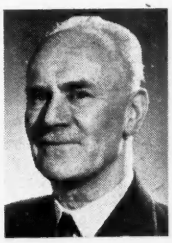
Mr. K. B. Strong

The Simplex Co. has appointed **Mr. G. A. Baillie** as Creda area sales engineer for Scotland. He will be based at the company's Glasgow office and operate under the general direction of Mr. J. M. Shannon, Simplex manager for Scotland. Mr. Baillie will be responsible for all Creda sales to the Electricity Boards in Scotland. During the last two years he has undertaken development work of water heating products at the Blythe Bridge factory. Mr. Baillie was formerly employed with

Archibald Low Electrics at Newarthill and was subsequently one of the original members of Duncan Low, Ltd., joining Simplex in 1953.

The General Electric Co., Ltd., announces that **Mr. D. A. Strachan,** A.I.Min.E., F.I.E.S., has been appointed to the head office of the company and will be responsible for

Mr. D. A. Strachan



Mr. S. C. Wells

flameproof and mining equipment sales. **Mr. S. C. Wells,** D.L.C.(Hons.), has been appointed to take responsibility for oil industry equipment sales.

Mr. Strachan for the past seven years has been lighting engineer at the London headquarters of the National Coal Board. Before joining the N.C.B. he was with the Metropolitan-Vickers Electrical Co., Ltd., at its Newcastle and London offices. He is a Council member of the Illuminating Engineering Society and of the London Branch of the Association of Mining Electrical and Mechanical Engineers. He has presented a number of papers dealing with the application and design of flameproof and other lighting equipment for use in hazardous locations, both here and overseas. For the past five years he has been chairman of the Mine Lighting Sub-Committee of the National Illumination Committee.

Mr. Wells received his technical education at Loughborough College and joined the Witton Engineering Works of the G.E.C. towards the end of 1923. A few years later he was transferred to the sales organization at head office and spent many years actively engaged on the export side of the company's business. He has made a number of trips overseas, including visits to the West Indies, Central and South America.

Mr. C. H. Nicholson, M.I.Mech.E., M.I.E.E., F.R.S.A., mechanical and electrical engineer (general duties), British Transport Commission, Docks, relinquished his post on 31st December and is now in private consulting practice. Mr. Nicholson was trained at the Hull College of Technology and after a short period with the Hull electricity supply undertaking joined the Hull & Barnsley Railway Co., and upon the amalgamation was appointed assistant mechanical engineer, Hull Docks, finally becoming chief docks machinery engineer to the London & North Eastern Railway Co. After the nationalization he was appointed mechanical and electrical engineer, Humber Ports, which post he held until his appointment as mechanical and electrical engineer (general duties), British Transport Commission, Docks. Mr. Nicholson was a member of the British Standards Institution Committees in connection with goods handling appliances, cranes, etc., and also chairman of the British Transport Commission Docks, Mechanical & Electrical Engineers' Technical Committee.

Mr. C. H. Jordan, sales director of Hague & McKenzie, Ltd., is to undertake an overseas tour of Central and South African markets, leaving on 3rd February. He will be visiting first the main centres in the Union of South Africa during February and the early part of March. The latter half of March will be taken up with a tour of Northern and Southern Rhodesia and Kenya.

Mr. W. G. Somerville has been appointed to the board of Davis & Timmins, Ltd., and becomes joint managing director. Mr. Somerville is forty-four years of age and has been in the service of the company for upwards of twenty-seven years, during the last three of which he has acted in the capacity of general manager. **Mr. E. A. P. De Waele** has retired from the board.

As from 1st January **Sir Ivor Cox** becomes deputy chairman of A.E.I. Overseas, Ltd., and will be succeeded as group managing director by **Mr. F. J. E. Tearle,** who also becomes a director of A.E.I., Ltd. Mr. Tearle, formerly a deputy managing director of A.E.I. Overseas, Ltd., recently signed the contract with the Indian Government whereby A.E.I. was appointed as consultants in a major project to create a heavy electrical industry in India. He began his association with A.E.I. as a college apprentice with the Metropolitan-Vickers Electrical Co., Ltd., at Trafford Park. He spent many years in Russia and became manager of the M/V Leningrad office. After service in the Navy during the last war he became principal representative of the Export Co. at Trafford Park and, in 1945, he joined the board of M/V. The accompanying picture was taken at the time of the signing of the contract with the Indian Government.

Lord Bicester has retired from the board of Associated Electrical Industries, Ltd.

Mr. F. E. Mills, until recently sales director and general manager, has been appointed managing director of B.I.P. Engineering, Ltd., Streetly, Staffs.

Mr. W. I. Pumphrey, M.Sc., Ph.D., who writes in this issue on "Metal-Arc Welding," has been research manager of Murex Welding Processes, Ltd., Waltham Cross, since 1951. He graduated at Birmingham University in 1942 after which he was with the Metallurgy Division of the National Physical Laboratory, his M.Sc. degree being based on his work at the N.P.L. From 1946 until 1949 he led the Welding Research Team for the Aluminium Development Association at the University of Birmingham, and was awarded his Ph.D. in metallurgy by that university in 1949. For the next two years Dr. Pumphrey was in the United States of America as holder of a Commonwealth Fund Fellowship. He is the author of some forty papers and a member of committees of the British Welding Research Association, the International Institute of Welding, the British Standards Institution and the British Iron and Steel Research Association.

Dr. W. I. Pumphrey

Mr. W. J. Cooper, M.B.E., M.I.E.E., retired on 31st December after forty-eight years' service in the electricity

Mr. Tearle and Mr. S. S. Khera, production secretary of the Indian Government, signing the contract for the appointment of A.E.I. as consultants in a project for the creation of a heavy electrical industry in India. Mr. V. N. Dixit, manager of the Delhi office of A.E.I. (India) is in the back row on the left

supply industry. After service with the Burgh of Wishaw, the Clyde Valley Electrical Power Co., the Yorkshire Electric Power Co., and Edmundsons Electricity Corporation, Mr. Cooper was in 1926 appointed burgh electrical engineer of Hamilton, which post he held until 1948 when he was appointed administrative officer of the South West Scotland Electricity Board, subsequently becoming liaison officer and personal assistant to the chairman and deputy chairman. Mr. Cooper was closely identified with the formation of the Electrical Power Engineers' Association and became the first chairman of the Scottish Division. He was for sixteen years hon. secretary and treasurer of the Scottish District Joint Board and the Scottish District Joint Council and since 1948 has been a member of the district negotiating and advisory bodies in South West Scotland. He was also the South West Scotland Board's member of the National Joint Council and its alternate member of the National Joint Board and the National Joint Industrial Council.

Mr. Hugh G. Balfour, assistant managing director of the Power Securities Corporation, Ltd., has been appointed deputy chairman. **Sir Ralph Stevenson** and **Mr. E. R. Wilkinson** have been elected directors.

Mr. Wilkinson has been appointed a director and deputy chairman of Balfour Beatty & Co., a subsidiary of the Power Securities Corporation. **Mr. R. H. R. McGill** has been elected to the board of Balfour Beatty & Co.

Mr. Ian C. A. Murray has retired from the board of Balfour Beatty & Co. He has also retired from the boards of Power Securities Corporation and its other subsidiaries—Duncan Watson (Electrical Engineers), James Kilpatrick & Son, and the Metropolitan Construction Co. **Mr. H. W. Gill,** joint secretary of Balfour Beatty & Co., has retired after nearly forty-seven years' service with the company. He has been succeeded as joint secretary by **Mr. H. A. Warren,** who is also joint secretary of the parent company—Power Securities Corporation.

At the annual general meeting of the Associated Manufacturers of Domestic Electrical Appliances (A.M.D.E.A.), held in December, the following officers were re-elected for the year 1955-56:—Chairman, **Mr. Felix A. Rogers,** and vice-chairman, **Mr. F. L. Humber.**

F. H. Wheeler & Co., Ltd., announce that **Mr. J. W. Trayler,** the company secretary, has been elected to the board and **Messrs. E. E. Fields, G. G. Kitchener** and **J. S. Smith** have been appointed technical directors.

Mr. H. B. Jones has been appointed sales manager (cable division) of Aerialite, Ltd., Stalybridge, Cheshire. He was previously employed as area manager and engineer at the Manchester Branch of the St. Helens Cable & Rubber Co., Ltd., Slough.

The staff of **Dimplex, Ltd.,** Millbrook, Southampton, were the guests of Mr. E. J. Wade, managing director, at the company's New Year staff party held last Saturday at the Little Testwood Country Club in the New Forest. A full programme of entertainment included dancing to the music of the Dave Roger's Trio and party games. Mr. D. N. Dale was M.C.

The annual presentation of long-service awards of certificates and gold wrist watches to employees of **Ferranti, Ltd.,** was made by Sir Vincent and Lady de Ferranti on 21st December at the Hollinwood offices. Two of the recipients were Mr. and Mrs. H. Wilson, who have completed forty and thirty years' service, respectively, with the company.

The Leeds Branch of the Electrical Industries Benevolent Association has received a sum of over £63 as a result of a staff dance organized by Mr. H. W. Sellers to celebrate the diamond jubilee of **Casperson, Ltd.,** of Leeds.

The **Institution of Electrical Engineers** reminds members that tickets are still available for the dinner-dance which is to be held by the Utilization Section at the Café Royal, Regent Street, W.1, on 18th January (7 for 7.30 p.m.). Applications should be made to the secretary of the Institution, Savoy Place, London, W.C.2.

The annual general meeting of the Birmingham branch area of the Electrical Industries Benevolent Association was held at the Imperial Hotel, Birmingham, recently, when the following officers were elected for the coming year:—President, **Mr. R. L. Batley,** O.B.E., A.M.I.Mech.E.; chairman, **Mr. F. A. Bartlam;** hon. treasurer, **Mr. H. J. Bick;** and hon. secretary, **Mr. F. Williams.**

Nearly 250 employees of the **Automatic Telephone & Electric Co., Ltd.,** who were successful in technological examinations during 1955, received their awards recently from Mr. J. A. Mason, director and manager, at a ceremony held at the company's main Liverpool works. Commenting on the large increase in prize winners, Mr. Mason said that this was a most encouraging return for the comprehensive facilities the company placed at the disposal of all its employees for study.

The annual general meeting of the Northern Counties Area of the **Electrical Industries Benevolent Association** will be held on 12th January (3 p.m.), in the Lecture Theatre, Carliol House, Newcastle-upon-Tyne, 1, under the chairmanship of Mr. J. Gibson.

During the year ended November last a total of £536 was allocated by the works committee of the **Belmos Co., Ltd.,** of Bellshill and Blantyre, Lanarkshire, to various hospitals, charities and benevolent associations. The local hospitals benefited by £145 and institutions for the blind by £77; £85 was donated to the welfare of children.

OBITUARY

Mr. Leslie B. Marshall, A.M.I.E.E., A.M.I.Struct.E., who had been sub-area engineer of the No. 6 (Lakeland) Sub-Area of the North Western Electricity Board since 1st March, 1954, died on 19th December at the age of fifty-six. Mr. Marshall was a native of Wolverhampton and was educated at Brewood Grammar School and Wolverhampton Technical College. He had experience with the Electric Construction Co., Ltd., the Wolverhampton Corporation Electricity Department, the Borough of Islington and the North Wales & District Electricity Supply Co., Ltd., before joining the Westmorland & District Electricity Supply Co., Ltd., as engineer and manager in 1933. He occupied this position for fifteen years until, on nationalization, he joined the Board's No. 6 Sub-Area as senior assistant engineer (construction). He held this post until his promotion to sub-area engineer.

The late Mr. L. B. Marshall

Mr. H. E. Ferguson, who was the general manager of the former Clyde Valley Electrical Power Co. from 1933 until his retirement five years later, died in Glasgow on 19th December. Before being appointed general manager he had been secretary of the company for twenty-two years.

Mr. J. E. Chester. — The death occurred on 26th December, at the age of sixty-eight, of Mr. John E. Chester, who spent many years in the photographic industry before joining the "Atlas" Lighting Division of Thorn Electrical Industries, Ltd., in April, 1943, as a sales representative, later specializing in photographic and projector lamps.

Sir Richard Redmayne, who was chief inspector of mines from 1908 to 1919, died on 27th December at the age of ninety.

Mr. J. H. Whitfield.—The death occurred on 28th December of Mr. John H. Whitfield, vice-chairman and joint managing director of Dictograph Telephones, Ltd.

Mr. George Levy, vice-chairman since 1928 of George Cohen Sons & Co., Ltd., died on 20th December at the age of seventy-one.

New Year Honours

RECIPIENTS OF AWARDS IN THE ELECTRICAL INDUSTRY

The New Year Honours List published on Monday last includes the names of many well-known men in the electrical and allied industries. From the list we have selected the following names.

Colonel C. E. Ponsonby, T.D., D.L., a director of Standard Telephones & Cables, Ltd., is created a baronet; **Mr. W. C. M. Couch,** C.B.E., M.I.E.E., Deputy Director of Electrical Engineering, Admiralty, and **Mr. W. J. Richards,** C.B.E., Director, Radar Research Establishment, Ministry of Supply, become Companions of the Order of the Bath (C.B.); **Brigadier R. Gambier-Parry,** C.M.G., a director of Varilectric, Ltd., has been appointed a Knight Commander of the Order of St. Michael and St. George (K.C.M.G.); **Mr. E. R. Wilkinson,** M.I.E.E., formerly commercial manager, Central Electricity Authority, and now deputy chairman of Balfour Beatty & Co. and a director of the Power Securities Corporation, Ltd., is appointed a Companion of the Order of Saint Michael and Saint George (C.M.G.); and **Sir Claude Gibb,** C.B.E., F.R.S., chairman of C. A. Parsons & Co., Ltd., becomes a Knight Commander of the Order of the British Empire (K.B.E.).

New Commanders of the Order of the British Empire include **Captain C. F. Booth,** O.B.E., M.I.E.E., assistant engineer-in-chief, General Post Office; **Mr. H. V. Disney,** chief engineer, Industrial Group headquarters, Risley, United Kingdom Atomic Energy Authority; **Mr. L. D. Harkess,** Director, Contracts Department, G.P.O.; **Mr. H. F. Hodgson,** managing director, Joseph Sankey & Sons, Ltd.; and **Mr. J. C. Lithgow,** M.I.E.E., for services to the Uganda Electricity Board.

Mr. W. C. M. Couch

Mr. E. R. Wilkinson

Sir Claude Gibb

Mr. C. F. Booth

The following are appointed Officers of the Order of the British Empire (O.B.E.): **Mr. J. T. Byrne,** M.B.E., J.P., area secretary, West of Scotland, Electrical Trades Union; **Mr. F. J. Cowlin,** M.I.Mech.E., chief engineer, Steam Turbine Division, English Electric Co., Ltd.; **Mr. A. A. Howgrave,** principal inspection officer, packaging, Inspectorate of Electrical and Mechanical Equipment, Ministry of Supply; **Mr. W. J. Huggett,** A.M.I.E.E., a director of the Express Lift Co., Ltd., and until recently manager, Marine Department (Carrier Equipment), General Electric Co., Ltd., Fraser & Chalmers Engineering Works; **Mr. C. W. Oatley,** M.A., M.Sc., M.I.E.E., Reader in Engineering, University of Cambridge; **Mr. H. Parish,** chief engineer, Henry Wiggin & Co., Ltd.; **Mr. H. Weston,** M.I.E.E., generation engineer, Belfast Corporation Electricity Department; and **Mr. R. V. Trace,** Director of Public Works, Electricity and Land Survey, Zanzibar.

The list of new Members of the Order of the British Empire (M.B.E.) includes the names of **Mr. A. Bowen,** mechanical engineer, British Thomson-Houston Co., Ltd., Rugby; **Mr. R. C. Butters,** chief machine progress superintendent, English Electric Co., Ltd., Stafford; **Mr. C. C. Davies,** electrical engineer, Admiralty; **Mr. G. E. Drewett,** divisional superintendent, Westinghouse Brake & Signal Co., Ltd.; **Mr. G. W. Essex,** A.M.I.E.E., deputy labour relations officer (headquarters), Central Electricity Authority; **Mr. G. Gunn,** A.M.I.E.E., generation engineer (operation), South of Scotland Electricity Board; **Mr. J. Haigh,** draughtsman, Whipp & Bourne, Ltd.; **Mr. R. H. Harral,** M.I.E.E., M.Inst.F., Sub-Area manager, North Western Electricity Board; **Mr. R. G. Hodges,** senior experimental officer, Radar Research Establishment, Ministry of Supply; **Mr. R. F. Holliday,** area engineer, London Telecommunications Region, G.P.O.; **Mr. A. Ibbotson,** chief draughtsman, Plant Department, Metropolitan-Vickers Electrical Co., Ltd.; **Mr. A. O'Sullivan,** service manager, S. G. Brown, Ltd.; **Mr. G. E. Randall,** radio officer, s.s. *Scottish Hawk,* Siemens Brothers & Co., Ltd.; **Mr. D. C. Rogers,** A.M.I.E.E., section head, Standard Telephones & Cables, Ltd.; and **Mr. W. R. Rose,** chief mechanical designer, General Electric Co., Ltd., Telephone Works, Coventry.

Recipients of the British Empire Medal (B.E.M.) are **Mr. N. Baxter,** electrical tester, Metropolitan-Vickers Electrical Co., Ltd., Manchester; **Mr. E. Bennett,** substation attendant, London Electricity Board, Kilburn; **Mr. C. Brook,** electrical fitter, Yorkshire Electricity Board (Holmfirth); **Mr. M. J. Brown,** technician Class I, Portsmouth Telephone Area, Southsea; **Mr. D. Clarke,** leading steam turbine driver, East Midlands Division, Central Electricity Authority, Derby; **Mr. H. Cole,** toolroom foreman, Joseph Lucas (Batteries), Ltd., Birmingham; **Mr. E. Edwards,** foreman linesman, North West, Merseyside and North Wales Division, C.E.A., Cheadle; **Mr. R. A. Grant,** auxiliary plant attendant, Midlands Division, C.E.A., Birmingham; **Mr. W. M. Jardine,** technical officer, Glasgow Telephone Area, Glasgow; **Mr. E. W. Jones,** underground switchboard operator, Elliot (East) Colliery, South Western Division, National Coal Board (New Tredegar); **Mr. J. J. Liddle,** chargeman fitter, North Eastern Electricity Board, Newcastle-upon-Tyne; **Mr. J. W. McIvor,** electrician, Imperial Chemical Industries, Ltd., Billingham Division, Middlesbrough; **Mr. W. S. Russell,** inspector (engineering), Post Office Telephones, Aberdeen; **Mr. W. T. J. B. Sauer,** technical officer, Engineer-in-Chief's office, G.P.O., Croydon; **Mr. W. G. Scowen,** fitter's mate, South Eastern Division, C.E.A., Folkestone; **Mr. A. A. F. Tatman,** chargehand, Enfield Cables, Ltd., Enfield; **Mr. J. H. Walker,** unit adjuster, London Division, C.E.A., Worcester Park, Surrey; and **Mr. E. Yates,** foreman electrician, Beyer, Peacock & Co., Ltd., Manchester.

Mr. F. J. Cowlin

Mr. H. Weston

Mr. C. W. Oatley

Mr. A. Bowen

Unification of Engineering Standards

COPIES are now available in this country from the British Standards Institution, British Standards House, 2, Park Street, London, W.1 (price 10s) of the full, printed report of the ABC Conference which was held in New York last April between America, Britain and Canada on the unification of engineering standards. The purpose of the Conference was to smooth out some of the many small but highly important differences which still exist between British and North American practice in the design and manufacture of engineering fastenings. Some of the discussions were extremely technical in character and much time has since been spent in the interchange among those concerned in all three countries of draft reports on individual subjects, in order to ensure that the final version now published accurately reflects the views expressed and the area of agreement reached at the Conference itself.

Much of the initiative for this three-nation Conference was, as previously, taken by Britain, whose 17-man delegation was organized by the British Standards Institution and led by Mr. Stanley Harley, who at that time was chairman of the B.S.I. Engineering Divisional Council.

Among other notable features distinguishing last year's gathering from previous ones was the presence for the first time of official observers from all the British Commonwealth countries as well as Canada (though they have in the past been kept fully informed of progress).

The attitude and views of several of the Commonwealth nations were crystallized by Mr. Cyril A. Gladman of Australia who said, *inter alia,* " it is a matter of considerable importance to us that there should be some unification of techniques, practice and engineering standards among the English-speaking, inch-using nations."

On the other hand, it was made quite clear by Mr. Roger E. Gay, leader of the American delegation, and by Mr. Stanley Harley on behalf of Britain, that the Conference was in no sense an effort to set up an English-speaking " inch-bloc " to confront the countries in the International Organization for Standardization (ISO) which use the metric system.

Against the background of opinions expressed at the Conference it is not surprising that at its conclusion the Conference was unanimous in voicing the opinion that there had been too long an interval between this 1955 Conference and the preceding one (held in 1952), and that future conferences should be held at more frequent intervals and with a rather more limited field of study for each one.

In order to help to bridge the gaps between conferences, it was decided to extend the principle of appointing in all three countries correspondents for each subject of study, their function being to keep each other informed of domestic progress. It was also decided to continue the arrangement that the three national standards bodies should be kept posted by copies of the correspondence, in order that there might be in each country a central point which was kept well informed as to what was going on.

Record Plant Installation

NEW generating plant installed by the Central Electricity Authority during the year ended 31st December, 1955, provided an additional output capacity of 1,721 MW. This compares with 1,431 MW in 1954 and 1,539 MW in 1952, the previous highest annual total.

The additional plant, made up of thirty-nine turbo-generators with an aggregate installed capacity of 1,817·5 MW and fifty-six boilers with an aggregate evaporative capacity of 18,660,000 lb/hr, together with twelve diesel engine generators (21 MW), was installed in forty stations. Seven of these are new stations in which plant was commissioned for the first time. The figure of 1,721 MW includes 56 MW (sent out) in respect of two sets in the Clyde's Mill station which vested in the South of Scotland Electricity Board on 1st April last. Details of the new plant will be given in next week's issue.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Engineers as Administrators

IN commenting on my letter to the November *Electrical Power Engineer* in your leading article of 9th December you state that I quote " Sir Henry Self and Lord Citrine as regarding engineers as generally unsuitable for the higher managerial positions."

This is an unfortunate misunderstanding of the letter as Sir Henry Self was not quoted, nor do I believe Sir Henry holds such views. This is indeed confirmed, as you rightly point out, by his very wise appreciation of the realm of administrative training given at the 1955 Power Convention. It is, however, difficult if not impossible to reconcile this with Lord Citrine's gloomy forebodings in his paper " Human Relations in Industry " (*I.E.E. Journal,* October, 1955).

In fact it appears there is some variation of opinion on this matter at C.E.A. headquarters. Let us then hope that Sir Henry Self's counsel will prevail and that the technical staff will be shown the faith they are worthy of, that given the opportunity, which should be theirs first and foremost, they will prove their ability as administrators.

Nationalization is not a passport to organizational infallibility and the C.E.A. could do much worse than observe the great names in private engineering industry—engineers to a man.

Chester. A. JOLLY.

[We are sorry about the misunderstanding. Mr. Jolly was quoting from the discussion on Sir Henry Self's Power Convention paper—not the paper itself.—Editors.]

Coal Utilization Council

IN your issue of 30th December you referred to criticisms of this Council made at the annual meeting of Cannon (Holdings), Ltd., by their chairman, Mr. A. F. Oatley. In letters to the Press I have already corrected some of Mr. Oatley's mis-statements.

In the first place, the Coal Utilization Council is not, as Mr. Oatley suggested, a Government-sponsored organization, but is maintained by the producers and distributors of solid fuel and of domestic equipment in which solid fuel is used.

Mr. Oatley complained that my Council are " advising the use of smokeless fuels which they well know are in the shortest supply, even if the public could afford to buy them." What in fact the Council recommends is the use of solid fuel, including coke and other smokeless fuels when available (and supplies are increasing), in modern appliances, as the most efficient and economical means of continuous domestic heating.

J. S. WILLIAMS,
Director,
Coal Utilization Council.

London, S.W.1.

[Further reference to this matter is made in a leaderette in this issue.—Editors.]

INDUSTRIAL NEWS

Electrical Engineers Exhibition

The President of the Board of Trade, Mr. Peter Thorneycroft, is to open the fifth Electrical Engineers (A.S.E.E.) Exhibition at Earls Court on 20th March. He will also be the guest of honour at the subsequent luncheon which will be attended by leading figures in the electrical industry.

Announcing Mr. Thorneycroft's acceptance of the invitation Mr. P. A. Thorogood, general manager of the exhibition, says that this year's exhibition will be larger than ever before. Over 300 exhibitors have already taken space and more overseas visitors have accepted invitations to visit the display.

American Contract for Ferranti

Reuter reports from New York that the United States Army has awarded a $2,080,940 contract for transformers for the Dalles Dam to Ferranti's. In Washington an Army spokesman said the Ferranti bid was the lowest of ten received. The order went to the British firm because it was approximately 29 per cent below the lowest bid received from a United States company.

A company spokesman said the contract—equivalent to £743,192—was awarded on the basis of Ferranti's low bid in competition with American companies and a Swiss firm. The Dalles Dam is a hydro-electric project on the Columbia River on the borders of Oregon and Washington States. The contract calls for 18 single-phase 230 kV transformers and three 115 kV units. They will be built at Ferranti's Hollinwood factory.

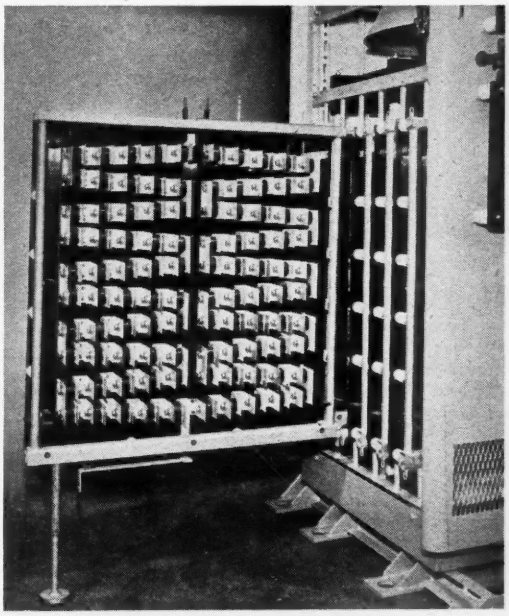
"Agreed" not "Collusive"

The Board of Trade has informed the Monopolies and Restrictive Practices Commission that the title of the Requirement under Section 15 of the Monopolies and Restrictive Practices (Inquiry and Control) Act, 1948, which was announced on 2nd November last, is to be changed from "Common Prices and Collusive Tendering" to "Common Prices and Agreed Tendering" to avoid any possible misconception that might arise from the meaning sometimes attached to the word "collusive." The change is solely in the title; there is no change in the terms of reference.

Germanium Rectifier Locomotive

The British Transport Commission announce that during the last few days successful trials have been carried out on the Lancaster-Morecambe-Heysham line (London Midland Region) with an electric train equipped with a B.T.H. germanium rectifier. Britain thus becomes the first country to utilize this development for converting a.c. from the overhead wire to d.c. for driving the traction motors. This notable achievement by British Railways stems from the pioneer work by the British Thomson-Houston Co., Ltd., in this field. The rectifier unit is air-cooled, and is of 750 kW capacity, arranged for full-wave rectification.

It is intended to continue with electric traction on the Lancaster - Morecambe - Heysham line, but the electric service has been temporarily suspended in order to modernize the overhead wire system, most of which has been in service for nearly fifty years. As soon as this renovation has been completed, electric working will be resumed and the germanium rectifier train will then enter passenger service.



B.T.H. germanium rectifier (750 kW) as used on locomotive, trials of which have recently taken place

Token Imports

The Board of Trade announces that the token import scheme will continue in 1956 for imports from Canada and the United States on the same basis as in 1955. Quotas will remain at the same level as in 1955—30 per cent by value of the average exports of the commodity in question to the United Kingdom in 1936-38. The total value of the quotas under the scheme is about £5 million a year. A notice to importers will be issued shortly by the Import Licensing Branch of the Board of Trade.

New Reflector Fluorescent Tube

The General Electric Co., Ltd., announces the introduction of a new "Osram" 4ft reflector fluorescent tube. The reflecting surface of the tube consists of an independent layer of powdered titanium dioxide bonded to the internal surface of the tube and applied in much the same way as a fluorescent coating. This material, which has a high reflection factor, is applied internally to the upper surface of the tube and extends over two-thirds of the circumference, with the result that most of the light generated throughout the fluorescent surface is directed downwards through the gap in the reflector. When these tubes are used in fittings having little or no directional light control they give nearly twice as much light on the working plane as the conventional 4ft tube. The new tube will be available in daylight colour, and its dimensions and electrical characteristics will be identical with the existing 4ft tube. It is priced at 13s 9d plus 2s 10½d purchase tax in the United Kingdom.

St. Pancras Resignalling

The contract for the supply and installation of the resignalling of St. Pancras Terminus, London Midland Region, has been awarded to the Westinghouse Brake & Signal Co., Ltd. This will include sixty-two sets of electro-pneumatic point layouts involving the installation of approximately two miles of air main and branch piping; sixty-two d.c. rectifier fed track circuits, covering a total of approximately four miles of track; nineteen field locations using forty-eight apparatus cases; 1,400 plug-in relays of various types, excluding the track relays, for various control functions; steel relay racks; compressor plant, including two electrically-driven compressors and one diesel-driven compressor with automatic starting and control gear. The main signals incorporating 2-, 3- and 4-aspect colour light signals, route indicators and subsidiary signals and "Westlyte" position light ground signals will be controlled by 205 route switches on

the control console which will be of the O.C.S. type with separate illuminated track diagram. This will be the second main line terminus in London to be equipped with electro-pneumatic point operation, the first being at Euston, which was installed by the Westinghouse Co. and brought into operation in October, 1952.

Equipment for Glasgow Trolley-Buses

The General Electric Co., Ltd., is to supply the electric traction equipment for thirty of the double-deck trolley-bus chassis which have been ordered by the Glasgow Corporation from British United Traction, Ltd. These equipments will incorporate the G.E.C. "I.R. control" system with rheostatic braking. While motoring, the motor series field is the main means of excitation, the separately-excited field being virtually inoperative and control being effected by means of armature resistance and series field diversion.

For braking, a portion of the series field is the primary means of excitation, while the separately-excited field exercises a controlling effect which protects against over-torque and stabilizes the braking effort over a wide range of speed. Air braking comes into operation automatically at low speeds, both systems being controlled by the same pedal. The self-ventilated motors will be of 125 h.p., and the cab-mounted butt-contact master controllers will provide automatic acceleration under the combined control of an oil dashpot and current limit relay. Provision will be made for manœuvring on batteries, the change-over switch being operated by the reverser handle, which can be removed for this purpose only when the reverser is in the "off" position.

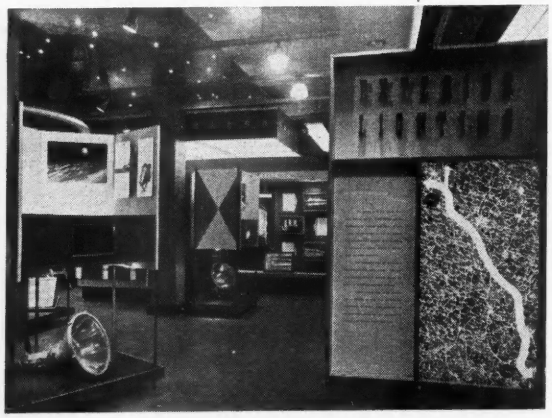
Exterior Lighting Exhibition

An exhibition dealing with exterior lighting opened at the "Mazda" lighting showroom of the British Thomson-Houston Co., Ltd., at Crown House, Aldwych, London, on Monday last. Street lighting and the lighting of docks, shipyards, railway stations, goods sidings and the floodlighting of buildings connected with sport all have a place.

The exhibition was designed by Robert Wetmore, M.S.I.A., in conjunction with the B.T.H. Lamp Advertising Department. "Invertrunking" has been used to suspend many of the lighting exhibits and also to carry false ceilings, which include a lumenated ceiling, and decorative panels carry the traditional figures of the constellations with the principal stars picked out in recessed "Mazda" pygmy sign lamps. Street lighting has been given the greatest prominence. This exhibit includes a traffic accident graph and sections dealing with current street lighting techniques and the latest lanterns, control gear and columns. A separate display deals with the production of sodium discharge lamps and the latest integral jacket sodium lamps.

Railway siding lighting deals principally with the latest form of high-power floodlighting; it is illustrated with a diorama and photographs of the installation at Lackenby Steelworks. Recently introduced floodlighting projectors exhibited include the "Mazda M.10" which houses the new horizontally operated 1 kW MA/H mercury discharge lamp and is used extensively for dockyard and shipyard lighting and a special projector for lighting railway platform extensions. Separate displays show the floodlighting in the Tivoli Gardens during the British Trade Fair at Copenhagen, special floodlighting for football grounds, greyhound tracks and tennis courts, lighting for petrol stations and decorative floodlighting.

General view of some of the exterior lighting exhibits at the B.T.H. showroom at Crown House, Aldwych, London, W.C.2



Portuguese Market for Electro-Medical Apparatus

A report has been prepared by the Commercial Department, British Embassy, Lisbon, on the market for electro-medical apparatus in Portugal and the adjacent islands. West Germany is the chief supplier of imported apparatus, British apparatus being considered expensive and rather conservative in style. Discussing the prospects for the sale of United Kingdom manufactures, the report states that consideration may have to be given to producing models which, while retaining high technical standards, sell more cheaply.

In recent years German and American apparatus of most types, Dutch X-ray apparatus and French apparatus other than X-ray, has been imported in larger quantities than United Kingdom apparatus. The only large-scale new customer—the new Oporto teaching hospital—is understood already to have placed the bulk of its orders. When these have been met demand for large-size apparatus may tail off slightly, though there will be a constant market for smaller-scale apparatus in clinics. The report includes tables showing the value of imports by countries for the years 1946 and 1951-54. It is published by the Export Services Branch of the Board of Trade, Lacon House, Theobald's Road, London, W.C.1, to which inquiries regarding the report should be made quoting reference E.S.B. 24669/55.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £179 os od
COPPER, H.C. Electro	ton £397 os od
Fire Refined 99·70%	ton £396 os od
Fire Refined 99·50%	ton £395 os od
COPPER Tubes ..	lb 3s 9½d
Sheet	ton £468 10s od
H.C. wire and strip ..	ton £444 15s od
LEAD, English ..	ton £120 5s od
Foreign	ton £119 os od
MERCURY	flask £89 os od
TIN, block (English) ..	ton £832 15s od
ZINC, G.O.B. Foreign	ton £101 10s od
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 3s od
Sheet	ton £362 10s od
Wire	lb 3s 7½d
PHOSPHOR BRONZE Wire	lb 5s 4½d
PLATINUM	oz £32 10s od
RUBBER, No. 1 R.S.S. spot	lb 36½d—37d

Engineering Wages Claim

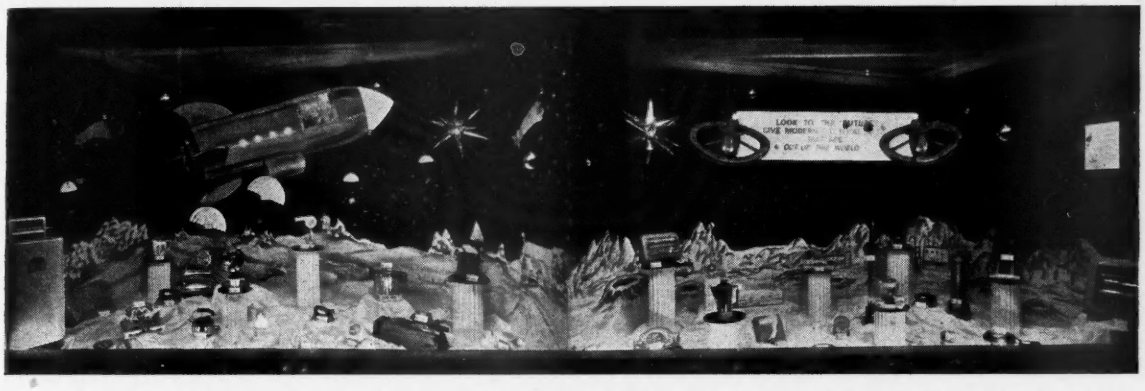
At a meeting last week between the Engineering and Allied Employers' National Federation and the engineering trade unions a claim was presented for an increase in the wages of employees in the engineering industry.

The unions' original claim was for "a substantial increase." At the meeting Sir Percy Mills, president of the Federation, said that it was difficult for the employers to deal with such a vague demand. He pointed out that at the present time any addition to costs would make it very hard for British engineering firms to compete successfully in export markets. He also stressed the danger of inflation.

After retiring to consider this the unions' representatives returned to say that they were asking for a 15 per cent increase.

The Federation is to consult its members on the subject and will give its reply to the claim at a meeting on 2nd February.

It is estimated that about three million workers are directly and



The display by the Chester Service Centre which, as reported in our last issue, was awarded the Eccles Shield in the Christmas window display competition held by the Merseyside and North Wales Electricity Board

indirectly concerned in this matter and that the cost to the industry of a 15 per cent increase would be between £150 and £200 million a year. The present minimum weekly rates are 155s 10d for skilled men and 132s 10d for unskilled.

Wages in the Contracting Industry

The Industrial Disputes Tribunal has rejected a claim for an extra 1d an hour for electricians employed in the electrical contracting industry made by the Electrical Trades Union and opposed by the employers' organization—the National Federated Electrical Association.

Mobile Demonstration Theatre

Commencing this week and continuing throughout the month a mobile dealer education centre of Kenwood Electrics, Ltd., is touring South Wales and the Midlands areas. The centre consists of a mobile caravan combining administration office, demonstration theatre and kitchen. The kitchen shows the many applications of food mixers for the ordinary domestic user and the special uses by which they can benefit the boarding house and small hotel keeper.

Technical Publications Association

Every year an increasing number of handbooks and manuals are issued by manufacturers describing correct methods of operating and maintaining their products, and many reach a high standard in content and presentation. One result has been to open up an expanding field of specialized employment and many undertakings now have technical publications departments of considerable size, staffed by competent technicians who are also trained writers and illustrators.

Something over a year ago the Technical Publications Association was formed to promote the interchange of ideas between technical writers and illustrators in industry. In addition to publishing a newsletter to members, the Association arranges frequent lectures and meetings, at which experts discuss aspects of publication work, and organize visits to printers, process engravers, and other trades of interest to those engaged in book production.

One of the Association's aims is to set up recognized standards of competency for technical writers and illustrators and in this direction it is collaborating with the City and Guilds of London Institute and other educational authorities with a view to establishing national examinations and certificates. The address of the Association is 46, Brook Street, London, W.1.

Canadian Industry and Trade

The November "Monthly Review" of the Bank of Nova Scotia speaks of the recovery in Canadian business since last April and considers that the outlook for the early months of 1956 is bright. One important fact is that work on the St. Lawrence Seaway project is now proceeding. Electrical appliance producers have had a much better year. Television sets, in particular, have been produced in much greater numbers; the total for 1955 was expected to be 900,000 units as compared with 600,000 in 1954. For most of the other major appliances the market now seems to be geared fairly closely to the rate of new residential construction. The volume of competitive imports decreased notably in 1954 and remained at a comparatively low level in 1955.

The "Review" goes on to say:—"Producers of industrial and electrical machinery have not been quite so fortunate in their struggle with foreign competition, but their difficulties have been alleviated by the upswing in capital investment programs. Domestic orders for electric power equipment and for railway cars and locomotives have increased, but export prospects for these products and for ships and farm machinery are not encouraging."

Transmission Line for Sudan

British Insulated Callender's Cables, Ltd., has received an order from the Sudan Light & Power Co., Ltd., for approximately seven miles of 33 kV aluminium - sheathed impregnated pressure cable for the new transmission line from Burri power station, Khartoum, to Omdurman. It is anticipated that installation work, which is to be carried out by the Sudan Light & Power Co. with the assistance of British Insulated Callender's Construction Co., Ltd., will commence in the spring or early summer. The route will include a crossing of the White Nile.

Floral Street Decorations

Christmas street decoration in Brussels has again been on a very large scale with impressive effect. With the drapes and runs of lamps on festoon cable large numbers of coloured fluorescent tubes have been used. For the first time "Miller-Kent" illuminated flowers have been installed; 500 were supplied by A. J. Miller, of Rainham, Kent.

Schoolboys' Own Exhibition

A novel device for determining which members of the rising generation may be seeking a job in the electricity supply industry is the centrepiece of the display provided by the British Electrical Development Association at the Schoolboys' Own Exhibition which is being held at the Horticultural Halls, Westminster, until 14th January. Boys are asked a series of questions and they then indicate their choice of answers by pressing the appropriate button on the machine, known as a careers calculating unit. The answers are then automatically sorted out by the unit and by a process of elimination the type of job most suited to the boy's talents appears in a panel. Four broad careers in the electricity supply industry are indicated in this way—crafts, commercial, technical and administrative. A fifth panel, for those whom the calculator shows to have no particular bent for jobs in the industry, announces "Try again later."

Girls are, of course, also catered for by the calculating unit. They have some alternative answers to select, and the four classes of employment for them are suited to the work of women in the industry.

Having decided on a possible future

career, and after having had the opportunity of seeking further guidance at an advisory counter, the future electricity supply industry employee is confronted by a series of fairground booths in which a demonstrator is seen cooking, a wireman wiring, a meter man testing, an agricultural representative coping with questions, etc.

The boys can also enter a competition, with prizes, in which the contestants are asked to select three of twelve illustrated ideas for making life easier with electricity.

Infra-Red Heating Installation

The new factory of Dexion, Ltd., at Waltham Abbey, has "Metrovick" infra-red projectors for the oven necessary to stove Dexion in the course of manufacture. The entire plant has been constructed from Dexion Angle by the firm's own engineers, and consists of degreasing, priming, painting, flash off, and infra-red stoving oven. The lengths of Dexion as they come from the machine line are suspended vertically from an overhead conveyor which takes them through the pre-treatment stages and finally through the oven, which radiates from one side only

"Metrovick" tubular sheathed element projectors paint stoving Dexion slotted angle

against polished reflecting panels forming the other wall. The infra-red equipment consists of 60 projectors. These are standard units with perforated metal outer cases containing the anodized aluminium trough-shaped reflectors and the tubular sheathed heating elements. The projectors are assembled in banks of ten with a total load of 180 kW.

Oldham Training Scheme

A new recruitment and training scheme for key jobs was announced by Mr. John Oldham, O.B.E., at the Christmas party held at Belle Vue by Oldham & Son, Ltd. He said that the new organization would be devoted to providing the right type of facilities and training. The chairman of the new Selection and Training Committee will be Mr. Orlando Oldham.

The Automatic Factory

We are informed that the book "The Automatic Factory: What Does It Mean," published by the Institution of Production Engineers and mentioned in our issue of 9th September last, has been taken over by E. & F. N. Spon, Ltd., 15, Bedford Street, London, W.C.2, who are publishing a reprinted edition at 30s on 20th January.

C.S. "Ocean Layer"

The new 4,600 ton cableship *Ocean Layer*, which recently returned from her maiden voyage to the Skagerrak where she successfully laid a submarine telephone cable between Norway and Denmark, has been chartered by Cable & Wireless, Ltd. She left the Greenwich works of her owners, Submarine Cables, Ltd., on 27th December for South America with about 1,200 nautical miles of submarine telegraph cable, weighing 3,650 tons. The value of the cable is approximately £650,000. She will carry out renewals to various cables on the east coast of Brazil between Recife (Pernambuco) and Vitoria, about 300 miles north of Rio de Janeiro. On arrival at Recife she will transfer certain shore-end cable to the C. & W. vessel, the c.s. *Norseman*, which will lay the shore-ends.

Change of Address

The Purchasing Department of the London Electricity Board is moving on 18th January to 6-9, Bridgewater Square, E.C.1 (tel.: Monarch 9898).

Trade Announcements

The **Brush Group, Ltd.,** has concluded an agreement with Maybach-Motorenbau G.m.b.H., of Friedrichshafen, Germany, under which Maybach have agreed to grant exclusive rights for the manufacture in the United Kingdom of the Maybach high speed lightweight range of MD diesel engines. Provision is made for these engines to be produced by a subsidiary company of the Brush Group, Ltd., to be formed for this purpose. The Maybach MD engine is suitable for use in locomotives with either electric or hydraulic drive, ships and industrial power plant.

The head office of the **Telegraph Construction & Maintenance Co., Ltd.,** and its associate company, Submarine Cables, Ltd., has now been moved to Mercury House, Theobald's Road, London, W.C.1, where they will occupy the first floor and part of the ground floor of the new Cable & Wireless, Ltd., headquarters building. The Telcon London sales office has also been transferred to Mercury House, together with the London sales office of the recently acquired Magnetic & Electrical Alloys, Ltd. The registered offices of the following associated and subsidiary companies of Telcon have also moved to Mercury House:—Sankey-Telcon, Ltd., Selborne Plantation Co., Ltd., Telcon-Magnetic Cores, Ltd., and Telcon Telecommunications, Ltd.

The head office, Southern Contracts Department and accounts office of **Clough, Smith & Co., Ltd.,** are now at Stephenson Way, Three Bridges, Sussex (telephone: Crawley 2060).

As from 1st January all "Warerite" materials made by **Warerite, Ltd.,** a subsidiary of Bakelite, Ltd., will be produced and sold by Bakelite, Ltd., still using the trade name "Warerite." The present trading policy will be continued, and the personnel will remain as at present with the exception that Mr. A. W. Sherwood, who has been manager of Warerite, Ltd., since 1945, will undertake new and wider activities in the Bakelite organization as sales promotion executive. Correspondence and inquiries for "Warerite" materials should be addressed to Bakelite, Ltd., at its head sales office, 12-18, Grosvenor Gardens, London, S.W.1, or to the area sales offices.

The London office and showrooms of **Bulpitt & Sons, Ltd.,** have been transferred to Kipling House, 43, Villiers Street, W.C.2 (telephone: Trafalgar 6600). A limited stock of spares is being carried, but no facilities for repairs are available. These must be sent as before to the Service Department, 115, Sandpits, Birmingham. Orders and correspondence should continue to be posted to the head office in Birmingham.

The **Northern Aluminium Co., Ltd.,** has opened a new sales office at 16, Cumberland Place, Southampton, Hants (telephone: Southampton 25425), and is to open another at 57, Bute Street, Luton, Beds (telephone: Luton 7364-5) on 16th January. The Manchester area sales office has moved to 23, Princess Street, Manchester, 2 (telephone: Central 9335).

Lancashire Dynamo Switchgear, Ltd., has transferred production from Bridgwater, Somerset, to its new works at Hurst Green, Oxted, Surrey (telephone: Oxted 1450).

Calendars, Diaries, etc.

Views of the Scottish Highlands form the calendar of Scottish Cables, Ltd., which has monthly sheets showing also the preceding and following months.

The calendar of Panelec (Great Britain), Ltd., illustrates buildings in which the company's floor warming equipment has been installed.

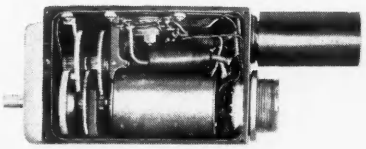
We have received a neat pocket diary bound in navy blue leather from B.I.P. Chemicals, Ltd.

The calendar of the Midland Electric Manufacturing Co., Ltd., has a picture of thatchers at work. The monthly sheets show also the preceding and following months.

NEW ELECTRICAL EQUIPMENT

Miniature Servo-Mechanisms

A series of miniature servo-mechanisms employing dithering-relay amplifiers to obtain positioning power are being produced in quantity by HARVEY ELECTRONICS, LTD., 273, Farnborough Road, Farnborough, Hants. They are based on an original design by the Low Speed Aircraft Research Association. The soap-cake-sized actuator illustrated is a miniature servo-mechanism designed for use with high-impedance output radio control receivers. A linear motion model (1in square by 5in long) is also available. It exerts up to 3 lb stalled and has a full travel time of less than 1 in/sec; it weighs less than 5 oz. Rotary models with an output of 100 deg/sec

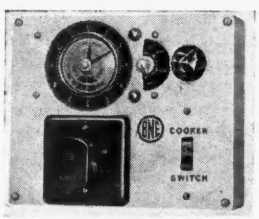


Harvey Electronics miniature servo-mechanism

travel have a stalled torque of 1 lb/ft for the type O servo and 4 lb/ft for type 1. The power consumption is 10 W maximum, while the idling current is well below 1 W. The accuracy of these servos without loads is 0·1 per cent and with a load of 50 per cent of maximum output an error of 1 to 2 per cent of full scale appears. The maximum repeatability error is less than 0·2 per cent.

Auto-Timer Cooker Control Unit

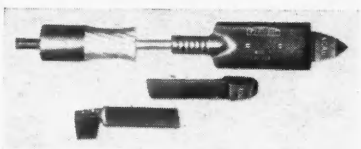
Originally known as the "Metalform" unit, the control panel now being marketed by BRITISH NATIONAL ELECTRICS, LTD., Newarthill, Motherwell, Lanarkshire, is claimed to be the only one to combine automatic timing with the usual mains control switch. It will also control the grill boiler and boiling plates if required. Certain modifications have been made and it will now be known as the B.N.E. auto-timer cooker control unit. It is housed in a heavy gauge sheet metal box, with ¾in conduit knockouts, which is treated for protection against rust and finished in cream stoved enamel. The overall dimensions are 7¼in high by 8⅝in wide by 2⅝in deep. It can be supplied for either flush or surface wall mounting. A 30 A mains switch is fitted and a pilot light indicates when the cooker is in circuit. The unit includes a 13 A outlet controlled by a separate switch for other appliances. A fused plug is supplied. The price is £7 10s.



B.N.E. auto-timer cooker control unit

Heavy Duty Soldering Iron

An extra heavy duty soldering iron produced by the ACRU ELECTRIC TOOL MANUFACTURING CO., LTD., Chapel Street, Stockport Road, Levenshulme, Manchester, 19, has been designed to cope with the soldering of the heavier gauges of sheet metal, wire, etc., and with the use of the company's special "A.1" solder it is claimed that even aluminium can be soldered.



Acru "Pyrobit 81" heavy duty soldering iron shown with interchangeable bits

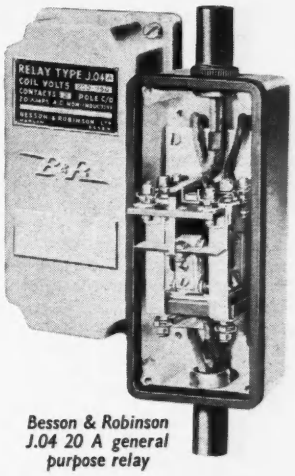
Of robust construction, the "Pyrobit 81" iron weighs 8 lb and its large heating area and size of copper bit render it suitable for constant use. The element is rated at 450 W, maximum heat being reached within 5 minutes.

The price of the iron, fitted with pointed bit as standard, is £5 10s. Interchangeable hatchet or chisel shaped bits are also available, price £1 10s each.

General Purpose Relay

BESSON & ROBINSON, LTD., East Industrial Estate, Harlow, Essex, have announced the production of a general purpose relay. Known as the J.04, it is quite small (3⅜ by 1⅞ by 2½in) but has contactor performance, the contacts having a continuous rating of 20 A at 250 V a.c.

To obtain the economies of large scale flow line production a two-pole change-over contact arrangement has been standardized. This meets a great many needs including nearly all single-phase mains switching. It has also been possible to standardize on a limited number of coils as each allows operation over a range such as 200-250 V, 50-60 c/s. Coil consumption is under 5 VA on a.c. and 2½ W on d.c., thus allowing operation over contact thermometers, etc.



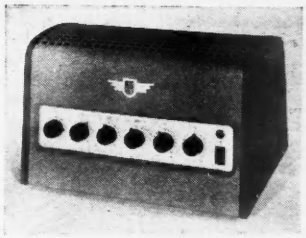
Besson & Robinson J.04 20 A general purpose relay

The relay is available in a weatherproof cast aluminium box measuring 7 by 3 5/16 by 3⅜in. A ¾in conduit entry is provided top and bottom with a channel for through cables behind the relay, which is on a special mounting plate to facilitate its temporary removal while installing the box and putting cables in.

The prices of the relay with standard coils for quantities of 12-250 are 35s each for the unmounted relay and 56s each when it is enclosed in a metal weatherproof box.

Audio Amplifier

A new 120 W amplifier (type EL 6431) is being marketed by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, at a retail price of £120. The main advantages claimed for this amplifier include high fidelity reproduction (frequency range 40 c/s-15 kc/s), easy operation, simple loudspeaker matching, low power consumption and reliability.



Philips type EL. 6431 audio amplifier

Five input points are provided, two of which are for microphones and have separate volume controls. The other three are for radio, gramophone or magnetic recorder with selector switch and common volume control. Separate treble and base controls are effective for all five inputs. The microphone and other channels can be mixed.

This audio amplifier which is fully tropicalized weighs 35 lb and measures 15½in by 11¼in by 10in.

NEW BOOKS

Worked Examples in Engineering Thermodynamics. By H. J. Smith and J. W. Harris. Pp. 495; figs. Macdonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 35s.

This book supplies examples taken from past examination papers set for the examinations for the University of London B.Sc. (Engineering) degree, the Higher National Diploma and Certificate and for the professional institutions in the subject of applied thermodynamics. The examples are stated separately from the solutions and full solutions are given for all the examples.

Preparation for the examination is the essential purpose of the book. The examples are numerous and cover all the sections likely to be met. The examples are well laid out, and the detail given in the solution is such as might be expected from the candidate in the examination. The thermodynamic context is thus limited to that made possible by its inclusion in an example set for solution in an examination. In many cases perhaps a greater fullness would have been desirable, but the authors have met this need by appending references to standard textbooks and the proceedings of the professional institutions. The idea is very good and could have had an extended use.

The solutions to the examples are well illustrated by diagrams and sketches, which should help to develop a good style on the part of the student. The theory in general is well stated, although there is a tendency to use formulæ and symbols directly where a written statement followed by the formula and symbols would have made for greater clarity and ease in reading the text.

The book will have great value for use for revision purposes for the final examination, but as a work to use continuously with the students' development of thermodynamic theory it is limited by lack of examples suited to progressive stages.—J.F.H.

Winding Engine Calculations for the Mining Engineer. By A. B. Price, B.Sc., A.M.I.Mech.E. Second edition. Pp. 152; figs. 47; charts and drawings 8. Fraser & Chalmers Engineering Works (General Electric Co., Ltd.). Price 30s.

This book, which was originally published in 1951, has been revised to include more details of friction winders of both Koepe and multi-rope types. The complexities of design are discussed at length with particular reference to the problems of the site engineer, and an endeavour has been made to deal with practice both in the United Kingdom and overseas.

All current systems are noted and a chapter on control schemes is useful in orientating the calculations to particular problems. For drum winders, calculations are given relating to cylindrical drums, B.C.C. drums and double drums; on friction winders, Koepe wheels and multi-rope winders are fully described.

A chapter is included on inclined shafts in which the mechanics of this method are considered. Calculations for steam winders form an end piece to the book. There are tables on ropes and also on moments of inertia for typical a.c. and d.c. motors, drums and reduction gears.

The book is being sent to colliery winding engineers in the United Kingdom and abroad. In addition, copies have been sent to county librarians in the coal-mining counties, and to the librarians of United Kingdom universities and mining schools. The company has given a number of copies to the Electrical Industries Benevolent Association, 32, Old Burlington Street, London, W.1, to whom application may be made for copies at the published price.

Principles of Electrical Measurements. By H. Buckingham and E. M. Price. Pp. 600; figs. 418. English Universities Press, Ltd., 102, Newgate Street, London, E.C.1. Price 37s 6d.

The basic aim of this book is to cover the electrical measurement syllabuses of the Higher National Certificate, A.M.I.E.E. and engineering degree examinations and at the same time to serve as a reference work for the practising engineer.

The book is unusual in that, in addition to the material commonly found in works on electrical measurements, i.e., the theory of meters, bridges, instrument transformers and the classical methods of measurement, it is extended to include chapters on the use of electronic instruments and r.f. measurements. These chapters, which are perhaps necessarily brief, deal with the principles of oscillators, amplifiers, valve voltmeters, wavemeters and the "Q" meter. It is still not generally appreciated that the intelligent use of resonant methods, i.e., the "Q" meter, results in quite good accuracy in many measurements at r.f. The advantages accruing from the use of inductively coupled ratio arms in bridge networks and the double ratio bridge are discussed. It is largely by these techniques that the frequency range of bridge methods has been extended from say 10 Mc/s up to several hundred Mc/s.

Another useful item which receives attention is the question of the overall accuracy which can be expected from a given system. This is a problem which is obviously of paramount importance but one which seldom receives adequate treatment.

The rationalized M.K.S. system of units is used throughout the book in conformity with current practice, but for the benefit of those who are still unfamiliar with this system a comparison is made with the c.g.s. system and a conversion table provided. The book, which is easy to read and not overloaded with mathematics, can be confidently recommended to the student, but its usefulness as a reference work is limited to some extent by the lack of references to original papers.—H.B.W.

Centenary of "The Engineer"

IT was on 4th January, 1856, that Edward Charles Healey brought out the first issue of *The Engineer* and so this week our esteemed contemporary celebrates its centenary—an event upon which we congratulate it. In its first issue *The Engineer* promised "strict impartiality" in its aim to "take cognizance of all new works relating to the useful arts and allied subjects" and it can fairly claim to have lived up to this aim.

Edward Healey was succeeded in due course by his son, later Sir Charles Chadwyck-Healey, Bt., who was prominent in public life. He, in turn, was followed by his eldest son, Sir Gerald Chadwyck-Healey, who was assisted by his brother, Oliver, as managing director.

In 1929 the owning company amalgamated with Morgan Bros. (Publishers), Ltd. A new company was formed with Sir Gerald Chadwyck-Healey as chairman, a post which he held until 1948 when his brother Oliver took over. Sir Gerald's younger son, Charles, is assistant managing director.

The first editor was a Mr. Allen (about whom little is now known), who was in charge until 1858 when he was succeeded by Zerah Colburn, an American. The beginning of a "dynasty" occurred in 1865 when Vaughan Pendred was appointed editor. Forty years later he was succeeded by his son, Loughnan St. Lawrence Pendred, and in 1946 Loughnan's second son, Benjamin W. Pendred, became editor-in-chief, a position which he still occupies.

To commemorate the centenary a mammoth edition of *The Engineer* has been produced. It consists of 452 pages (124 editorial and 328 advertisements) and weighs about 4½ lb. Distinguished authors have contributed articles on progress in all branches of engineering during the past hundred years and others survey developments in many ancillary fields. Sir Claude Gibb, F.R.S., writes on electrical engineering and Dr. H. A. Thomas on electronics. Nuclear power is dealt with by Sir Christopher Hinton, F.R.S. Altogether the issue forms a valuable and readable compendium of information on all phases of engineering and is a production worthy of the occasion.

A word should be said about the illustrations which include reproductions of some beautiful engravings from earlier days and a number of pictures in colour of modern products.

Automatic Control Systems

Some Observations on the Installation Work Involved

By J. RUSSELL HICKMOTT

EACH year several million pounds worth of electrically operated automatic controls are produced in this country. The increasing cost of all types of fuel has given impetus to the phenomenal growth of this business, which caters for the needs of industry and the domestic consumer alike with the production of a wide variety of equipment. Although the simple thermostat usually associated with an immersion heater has long been familiar to the electrical contractor, some of the more complex instruments have so far been restricted to a few specialist firms. To-day, however, many domestic premises are being equipped with

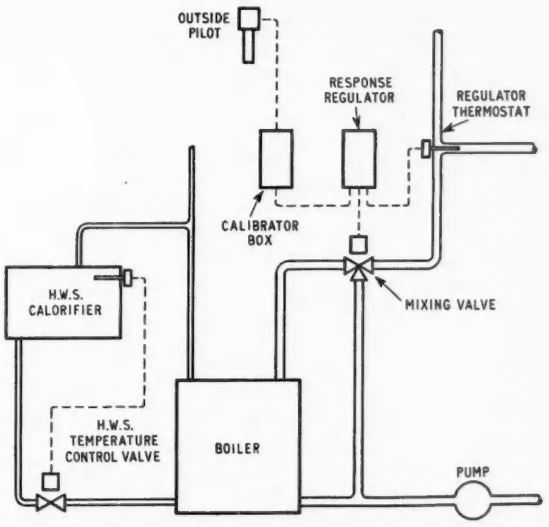


Fig. 1.—Basic arrangement of a typical domestic heating control installation

automatic controls and there is a growing demand for the electrical contractor who can wire the necessary circuits and test the installation to ensure that it is functioning correctly in the electrical sense.

In addition, a great deal of equipment is housed in control panels which are built for the individual job. These panels are relatively small wall mounted boxes of sheet metal construction in which the electrical equipment is fitted and wired to a numbered terminal strip. The production and wiring of these panels is well within the scope of even the smallest contractor and there is a consistent demand among many firms in the heating and ventilating trade.

Electronic techniques are increasingly being applied to automatic control problems so that the contractor who combines radio and electrical work has, in most instances, the basic equipment necessary for an approach to this new field.

The design and application of automatic controls is a specialist's job requiring a wide knowledge of technical problems, but in the domestic sphere the matter is largely restricted to heating and ventilating. In most cases, however, the actual installation work can be carried out by the progressive electrical contractor who is able to appreciate the practical functions of the control system.

A typical domestic or small industrial installation is shown in Fig. 1. It consists of a solid-fuel or oil-fired boiler feeding a radiator hot water heating system and the hot water supply cylinder or calorifier. The space temperature is automatically controlled by an inside/outside compensator which relates the radiator temperature to the outside temperature by means of a motorized mixing valve. In principle the equipment consists of an outside thermostat of special design, often called the outside pilot, which continuously adjusts the setting of the regulator thermostat in accordance with outside conditions. Thus, when the outside temperature is 30 deg F the regulator setting would be, say, 180 deg F. This means that the water circulating in the radiator system is at 180 deg F. As the outside temperature rises so the setting of the regulator is automatically depressed. For example, at 60 deg F outside the setting would be reduced to say, 110 deg F. Intermediate outside temperatures produce intermediate settings on the regulator. In this way the heat output of the heating system is proportioned to meet the rise and fall in heat requirements.

The regulator varies the flow temperature by means of the motorized mixing valve which admits more or less cool return water into the system to increase or lower the flow temperature. Again this action is of the modulating type and the response rate can be varied to suit the characteristics of the installation by adjustment of the response regulator. Similarly, the depression ratio of the compensator can be adjusted at the calibrator box. A further feature of the control system is an adjustment to increase the depression of the boiler flow temperature

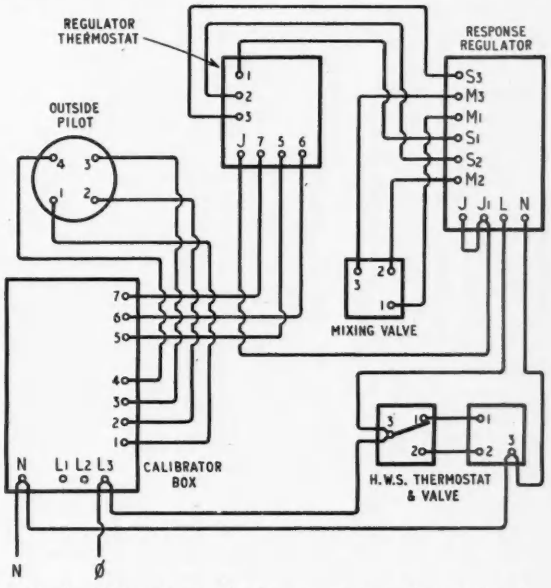


Fig. 2.—Wiring diagram for the control scheme shown in Fig. 1

at night. If required, this switching operation can be carried out by means of a synchronous time switch included in the circuit.

The hot water supply temperature is controlled by a thermostat with change-over switching fitted in the secondary of the calorifier and arranged to open or close a motorized butterfly valve in the primary return.

Fig. 2 shows the wiring diagram for the automatic control scheme described above. In such an installation there would be additional wiring work to include the accelerator pump and the time switch in the circuit. In the case of an oil-fired boiler there would be additional wiring to the burner automatic controls and to the automatic flame failure equipment. This latter item frequently requires certain circuits wired in shielded cable because the currents handled are extremely small and are fed to an electronic amplifier. It will be appreciated that the picking up of spurious currents from adjacent cables especially on a.c. circuits might easily be sufficient to trigger a sensitive amplifier.

It should be emphasized that the circuit shown in Fig. 2 is a comparatively simple arrangement. In the larger industrial installations there would be several sets of electrically driven pumps with isolators, change-over switches and starters, various additional thermostats for frost protection and high limit control and electrically operated temperature indicators and recorders. All these items are frequently included in a comprehensive wiring diagram which forms the basis of the electrical installation contract.

A number of manufacturers are to-day producing automatic controls for the domestic market including compensating equipment. In the small control panel field, however, there is wide scope for the electrical contractor because in most cases each job has a control panel which is designed and made for the particular installation.

It is evident that the installation of complex automatic control systems will become increasingly a part of every industrial heating and ventilating plant. In the domestic field there is abundant evidence that the age of push-button and automatically controlled equipment has reached the stage at which the electrical contractor must become involved.

Highland Water Power

DEVELOPMENTS of the North of Scotland Hydro-Electric Board were the subject of a paper by the late Mr. T. Lawrie (who until his death last August was general manager of the Board) and presented on his behalf before the Institution of Electrical Engineers' Supply Section on 5th January. During its first six years, dating from 1944, the Board was engaged on surveying and construction. The first schemes were set to work in 1950 with a capacity of 285 MW and 522 million kWh per annum, compared with 1949 totals (pre-war Grampian stations, etc.) of 87 MW and 322 million kWh. Corresponding figures for 1955-56 were expected to reach 634 MW and 1,620 million kWh, saving 960,000 tons of imported coal (over a fortnight's production of Scottish pits) valued at £5·76 million. Schemes now in hand would double these totals ten years hence.

Five major river systems contributed the bulk of the power, but numerous small local schemes were also being developed. The Board also operated steam stations at Dundee and Aberdeen and diesel stations in some of the islands without water power.

The highest dam was at Sloy, 168ft from base to spillway and the most massive was the Mullardoch—part of the Affric scheme—of the solid gravity type, 2,385ft long and 116ft high. For the Glen Moriston dam, 122ft high and 1,100ft long, near Inverness, 60 per cent economy in cement had been obtained by using blast-furnace slag. The first dam to be built entirely of pre-stressed concrete was being constructed in Glen Fyne, Argyllshire; its maximum height was 73ft and its length 1,375ft. Over 130 miles of tunnels had been made to date.

Rainfall varied from 40in/annum in the Eastern Highlands to 140in in the west and the dams would store 20 to 60 per cent of a year's rainfall. The difference between average run-off of water corresponded closely to seasonal variations in load. Average yearly rainfall had not since 1881 fallen below 80 per cent or risen above 129 per cent of the mean figure.

The highest individual turbine output was provided by a 40 MW 428 r.p.m. Francis set in the Clachan power station of the Shira scheme on Loch Fyne, which operated under a gross head of 960ft. The maximum head was 1,362ft for a single set comprising double overhung Pelton wheels driving a 30 MW 375 r.p.m. horizontal-shaft alternator. At Invergarry power station a 20 MW 250 r.p.m. vertical-shaft Kaplan turbine operated under the unusually high head for its type of 175ft.

A 132 kV grid line had been run from Fort Augustus across the Currieyairack Pass at a maximum height of 2,507ft. During the severe snowstorms of February, 1955, a linesman and transformer were dropped by helicopter near John O'Groats, to which there is a 33 kV connection. A 275 kV line would probably be erected from Beauly to Kintore in Aberdeenshire.

A 10 MW closed-cycle gas turbine was being installed to run on oil at Dundee and a similar 2 MW set was being built to run on peat (containing only 10 per cent of solid combustible) and coal at Caithness. The 100 kW wind-driven generator in Orkney was running, though not yet on a commercial basis.

For augmenting water storage, an experimental 5,000 kW pump was being installed in the upper Shira power station to return surplus water in wet weather from the lower dam to the main reservoir during off-peak periods. Pumped storage on a large scale might also be found of value in enabling nuclear and modern steam stations to run on steady load; possibly 2,000 MW could be desirably developed between 1961 and 1975 as a first stage, Loch Sloy offering a suitable site.

Three-quarters of the Board's hydro-electric power was consumed in its own supply area, the remainder being exported to South Scotland to meet peaks at 15 per cent load factor.

When the Board became responsible (in 1948) for electricity distribution 600,000 people (half the total population of its area), mostly scattered in sparsely populated districts, were without a supply. Two-thirds of them were now connected, including 45 per cent of farms and crofts, which was expected to become 70 to 80 per cent within the next decade. In the whole area of the Board, including towns, the increase in demand between 1947 and 1954 was 225 per cent. One promising electrical application was the blowing of heated air through hay for drying at a cost of £12/ton; the protein content had been increased from 6 to 11 per cent and one crofter reported a doubling of milk yield as a result.

Materials for the Electrical Industry

SUPPLIES AND PRICES DURING 1955

The following survey of the course of prices and events which have influenced the supply of the principal materials employed in the electrical industry has been specially prepared for us by the Metal Information Bureau, Ltd.

COPPER. — The past year was a remarkable one for the copper market. Not the least outstanding feature was the establishment of a record price on the London Metal Exchange of £404 per ton—a figure far in excess of anything anyone would have predicted. Indeed, when the year opened it was known that the market was in a firm condition with prospects of a continuing high level of demand in the world, at any rate for some months to come, but it was expected that there would be quite a substantial increase in global production and that the supply situation would gradually become less stringent.

In the event, the year opened badly with a prolonged strike of native workpeople at the huge Rhodesian mines which naturally had a powerful impact on a market already in close balance. The strike was not quite as serious as was at one time feared for by the use of " pipeline " stocks, and the efforts of the European mine staff, production was by no means stopped. Nevertheless, it meant that any hope of an easing in the supply position in the first half of the year was out of the question. Other labour troubles have dogged the industry, notably a lengthy strike at most of the main United States mines in the summer which very seriously curtailed production there just at a time when some hesitation about the American economic outlook was giving way to a resumption of boom conditions, following the settlement of the threatened strikes in the steel and motor car industries.

In Chile there was labour unrest on and off throughout the year, but prolonged strikes were avoided and production in that country is expected to have reached 400,000 tons in 1955. At the end of December, however, all the main mines were idle owing to a strike which may not be easily settled. In Great Britain the rail and dock strikes naturally caused a good deal of interruption to the normal flow of material and led to some high premiums being paid for electrolytic wirebars over the Metal Exchange price; at one time fully £25 a ton premium was obtainable for spot metal.

The high prices which have characterized the copper market have not been to the satisfaction either of consumers or producers. Both have been worried to see the growing use of alternative and substitute materials in traditional copper markets. The process is still going on and in the fullness of time could have serious repercussions on the future demand for copper. American primary producers have tried to follow a policy of rigidly controlled selling prices but have had to move their quotations up several times owing to higher production costs and threats from Chile that her production (mainly American owned) would be marketed elsewhere unless higher American prices were forthcoming. Even so there has frequently been a big spread between the primary producers' price and open market quotations in the United States as, indeed, there is at present, namely, a difference of 7 cents per lb or £35 per ton.

The Rhodesian Selection Trust group of companies early in the year announced their desire to introduce a measure of stabilization into copper prices for United Kingdom consumers and sought the co-operation of the other big Rhodesian producing group, but this was not forthcoming. Nevertheless, in May the Rhodesian Selection Trust group announced a price of £280 firm for a minimum of 30 days to selected United Kingdom consumers who agreed to pass on the advantage (the price was well below the open market price) to buyers of their products.

Except for a short spell of two or three weeks the open market ruled much above the R. S. T. quotations even though these were progressively raised to the present figure of £360. This has led to a dual price situation in many copper semi-finished products and can hardly be considered altogether desirable, although users are naturally grateful for anything that has helped them to avoid the marked fluctuations in open market prices and has also helped to keep copper more competitive. The price of copper is now such a long way above aluminium that it is hardly surprising that the lighter metal is being used in many applications in the electrical field, both in the United States and in this country. A good deal of new competition has also been met from plastics, notably in the form of tubes and extruded products.

Notwithstanding the growth of this competition all the available copper in the world has been very readily absorbed, and 1955 ended with the international market in a tight position, open market prices in the region of £400 a ton and no certainty when the situation is likely to ease. Production should increase further in 1956 and some big plans are in hand for further ahead, so that by 1960 it is probable that world output will be some 700,000 to 750,000 tons a year greater than it is to-day. The question that no one can answer at this stage is whether, in view of the loss of some of its markets to other materials, copper output will be fully absorbed by the rising world population and the upward trend of standards of living in nearly all countries.

Most consumers of the metal here have been made anxious by interruptions in supplies from one source or another so often now that in the main they are pursuing a policy of forward buying to keep themselves more fully covered than at any time since Government control of the metal ended.

One reason for the high level of demand for copper wire and cables during the past year has been the large exports of this class of material to Russia and " Iron Curtain " countries, the total in the first ten months of the year amounting to well over £6 million. Whether this demand will continue in the coming year it is impossible to foresee, but some recession in the quantities required is at least a possibility. Competition from aluminium might have been even more serious but for the tightness in supplies also of that metal which looks likely to continue, for the time being at any rate.

In the first ten months of 1955 the United Kingdom consumed 541,000 tons of copper, compared with 474,000 tons in the corresponding period of 1954. For the whole year consumption certainly reached 600,000 tons.

TIN.—In the first three quarters of 1955 the tin market displayed few outstanding features. Early in the year the requisite number of producing and consuming countries signed the International Tin Agreement, but whilst most of them have now ratified it, Indonesia has not yet done

so and until she does it cannot be put into operation. The United States Government has continued to buy substantial quantities of tin ore and concentrates from Bolivia and Indonesia and in all has been taking off the market and stockpiling something like 22,000 to 23,000 tons of tin a year. This about bridged the gap between production and world industrial requirements in the early part of the year, but in the past twelve months there has been a steady rise in consumption in the main tin-using areas and particularly in the United States, with the result that the supply position has been getting tighter for months past and in the closing months of the year this became more and more apparent.

Consumers began to find spot metal hard to get and in consequence they began to buy more freely and further ahead than for a long time past. This was naturally reflected in higher open market prices, up to £840 a ton being paid recently, with even higher figures in America. The American Government now has vast quantities of tin in its strategic stockpile and at present proposes to cease operations after 30th June next at its wartime smelter at Texas City which it is now trying to sell to private interests —but so far with little success. The outlook for 1956 is one of continuing good demand, with the possibility of an increasing stringency in supplies in the early months whilst American Government buying continues. If Indonesia ratifies the International Tin Agreement it may be put into operation this year which should offer the market a good deal of support should the need arise.

ZINC.—The past year witnessed a considerable strengthening in the general position of zinc, mainly owing to a marked improvement in the position in the United States. When the year opened, American producers' stocks, although below the peak, were still large, and the market there was relying month by month on appreciable Government purchases for the strategic stockpile to keep it in reasonable balance. As the year progressed, however, demand broadened, most noticeably in the field of zinc alloy diecastings, which now represent the largest single use of zinc in the United States and absorb a substantial proportion of the total supplies. As a result, in the closing months of the year only token quantities were being offered to the stockpile and producers' stocks fell to the lowest figure for a number of years.

This improvement in the American situation took place against a background of a satisfactory level of consumption in the United Kingdom and Europe generally, with the result that by the end of the year the world supply position of zinc had become a good deal tighter than it was in the earlier months. Prices on the London Metal Exchange, which had opened the year in the low £80's, were up to around £100 a ton, or effectively the highest level since free trading in the metal was resumed on the London Metal Exchange after the war.

In the United Kingdom the zinc alloy diecasting industry also had a very good year, accounting for something like 40,000 tons of special high grade zinc and for most of the period this grade has been in rather tight supply —with prospects that a similar state of affairs will prevail in 1956. The brass industry also enjoyed very active trading conditions and galvanizing had quite a good year, the galvanized sheet makers being perhaps rather more actively employed than the general galvanizers. With every prospect of boom conditions continuing in the United States for some months, 1956 looks like getting off to a very good start, even though there are some doubts whether United Kingdom consumption this year will quite match the very satisfactory level achieved in 1955.

In the first ten months of last year 286,398 tons was consumed, against 267,272 tons in the same period of 1954, so that for the whole year there was probably an offtake of some 350,000 tons of which very nearly 250,000 tons was new zinc.

There has been some resistance recently in the United States against higher prices for the metal, but if the present strength of the market persists a future upward movement in quotations seems probable.

LEAD.—This metal shared in the general progress registered by non-ferrous metals in 1955, although in the first half of the year the market was no more than steady. Indeed it would probably not have been so stable had it not been for the continued absorption of appreciable quantities by the American strategic stockpile as a means of keeping the American domestic market steady and enabling producers there to maintain production. During the year, however, not only did demand in Europe show some expansion, but there was considerable improvement in the American domestic market as a result of which, in the closing months of the year, American requirements of imported metal increased.

With exporting countries finding the United States market rather more attractive than Europe, smaller shipments to the United Kingdom and a continuing high level of demand here led to higher prices. If demand in 1956 is maintained at recent levels, there seems to be a chance that prices may move up further, as present indications are that the United Kingdom may have to raise its quotations to compete with America in attracting more Mexican, Australian and Canadian lead to this side. If this happens there is every chance that the American price will be raised in turn.

The improvement in United Kingdom consumption during the past year, which has been of the order of 10 per cent, has been mainly due to a recovery in the cable industry, which has reasserted itself as the main outlet for lead. So far the threat of competition from aluminium in cable sheathing has not become unduly serious, though it certainly exists and may increase if lead prices rise. The high level of activity in the motor car trade has, of course, been generally reflected in a continued large demand for batteries, but actual consumption of lead in this field has not risen very markedly. The other interesting development in the past year has been the further growth in the production of lead tetraethyl in this country, an outlet now absorbing fully 20,000 tons of lead a year.

ALUMINIUM.—In broad terms, the world market in aluminium in 1955 was characterized by a growing scarcity. As the year opened, the industry was in a healthy condition and was looking forward to a boom year; there was then no shortage of raw metal and few people imagined at that time that the year would end with quite a serious world shortage of the metal.

The alteration in the position may be ascribed to three factors, which are, in order of importance: the strong growth in "normal" demand, the increasing tendency to substitute aluminium for copper, and the weather. Although the effects of the weather were indeed felt in 1955, it will be mid-1956 before the impact on the world market of the remarkably dry summer which both Europe and America experienced has been fully developed. Not only Canada, the biggest international supplier of aluminium, but also Norway and the United Kingdom have been affected by water-power deficiencies. Now that the frost has descended on Canada, the position is likely to get yet tighter before any relaxation is experienced.

Copper, as this review notes elsewhere, has been beset by strikes in 1955, resulting in wide variations, even in

allegedly "pegged" prices, and a marked decrease in popularity. This was particularly marked among electrical manufacturers, who found that, by adopting technical modifications, often quite small, they could enjoy the considerable economic advantages of aluminium. In the field of power cables, A.C.S.R. has remained a pre-eminent type; the progressive electrification of various underdeveloped Asian countries has helped to swell the demand for aluminium for this use.

In the last resort, however, the most important factor in the aluminium market has been the strong expansion of established uses, and the development of new ones (apart from those at the expense of copper). In the United States, especially, there was hardly an accepted use which did not advance in 1955, whilst the growth of certain new uses was phenomenal. As a result, it is becoming apparent that the big expansion plans in hand in America and Canada will, when they become effective, do no more than catch up with the remarkable expansion in demand.

IRON AND STEEL.—The British steel industry is estimated to have produced 19·75 million tons of raw steel last year against 18·52 million tons in 1954. Yet despite this big increase many consumers have gone short of steel and at least one works has been forced to close. In an effort to bridge the gap between home supplies and demand, imports of foreign iron and steel rose to an estimated amount of 2·5 million tons, compared with 0·76 million tons in 1954, while exports, despite a tremendous overseas demand, were kept down to about 2·75 million tons against 2·4 million tons in 1954. The boom in steel has been world-wide and other big producing countries like the United States and Western Germany (the latter now makes more steel than the United Kingdom) have not been able to produce enough steel to meet the needs of their internal markets and essential exports.

So far as this country is concerned a little pig iron production was lost early in the year owing to iron ore and coke shortages but record imports during the summer months improved the ore position considerably. The rail strike was perhaps a more serious blow; it resulted in an estimated loss of about 150,000 tons of raw steel.

Sheet steel has been one of the tightest items and imports have totalled nearly half a million tons, the bulk coming from the United States. The motor car industry has been heavily dependent on imported sheet steel, as have many smaller consuming industries. The largest single imported item has been pig iron at around 600,000 tons. Pig iron output has risen to record levels but is still obviously insufficient to meet the full needs of the melting shops. Russia has been a big supplier of pig iron to the United Kingdom, but iron has also come from as far away as India and Brazil. Semis have been brought in on a large scale, including billets from Chile, but as the year drew to a close imports of this class of material showed signs of slackening. Imports of most steel products have been encouraged by the suspension of import duties.

Despite the demand at home, it has been essential to keep the export markets open, and although shipments have been curtailed, substantial tonnages have been sent abroad, especially to the Commonwealth.

Modernization and rationalization have enabled the steel industry to absorb some of the higher production costs of the past year, but increases in home prices have been necessary to meet the higher costs of coal and ore, increased railway rates and general wage increases. Export prices of most products have risen, reflecting the upward trend of world quotations.

There are no signs of any slackening in the demand for steel; all the consuming industries are active, although stocks in the hands of consumers are certainly growing. The steelworks' order books will keep them occupied for many months to come. Adequate stocks of ore have been built up for the winter in spite of the intense competition for shipping space resulting from the need for substantial European coal imports, and the industry confidently believes that barring untoward circumstances it should be able to increase steel output in 1956 to 21 million tons.

RUBBER.—During 1955 world demand for rubber remained at a very high level and, despite the substantial tonnages of synthetic rubber which are now available, the pressure of demand for natural rubber has raised prices to levels which, not so very long ago, would have seemed impossible. Spot ribbed smoked sheet opened the year at 31⅛d per lb and after declining to 26d in March shot up to 42d in August. Thereafter it eased a little but was appreciably over 3s a lb at the end of the year.

World consumption of rubber during 1955 is estimated to have amounted to 2,900,000 tons and some recent American estimates have projected a rising trend to a figure of some 3,500,000 tons by 1960. There is every indication, however, that the production of synthetic rubber is growing very fast and the prospects are that, although natural rubber should hold its own in those fields where it is technically preferable, notably in heavy lorry tyres, it may only do so at more competitive prices.

Leading interests are endeavouring to face the situation by extensive replanting programmes with high yielding bud-grafted rubber trees. Meanwhile, production of synthetic rubber is to be started in the United Kingdom, partly because the growth of demand is at a rate that can hardly be matched by expansion in the output of natural rubber (owing to the length of time it takes to bring a rubber tree into production) and partly because, in a number of applications, synthetic rubber is now preferred to the natural product on technical grounds.

It is fairly evident that, although a hopeful view is taken of the outlook for rubber generally, the natural rubber producers are not relying on continuing to get the high prices which prevailed during the greater part of last year. The expansion of the electrical and cable industries in this country has, of course, been a factor in rubber consumption during the year, but on a tonnage basis the motor tyre industry is undoubtedly the dominating factor. On both sides of the Atlantic motor car makers are planning for increased output. Eventually, it is felt, competition between natural and synthetic rubber should result in more and better rubber products at lower cost.

I.E.E. CHRISTMAS LECTURE

ON Thursday and Friday last week at the Institution of Electrical Engineers Mr. R. Brooks, B.Sc., gave a Christmas lecture for older school children on electric traction. The lecturer outlined the principal features and methods of operation of the different systems of electric traction now in use, and the development of the modern traction motor was traced from the basic work of Faraday through some interesting forms of early "electro-magnetic engines." The extent and distribution of electric traction throughout the world was illustrated by a special map.

The lecture included an "arm-chair" trip in the driver's cab of a modern electric locomotive, operating the controls. As an example of the self-contained type of locomotive, the basic principles of diesel-electric operation were described and illustrated. Finally, a short talk was given on the main principles of electric railway signalling together with a demonstration of full-size apparatus including searchlight type signals. The lecture was illustrated with lantern slides and demonstrations of some items of electric railway apparatus connected up and operating.

Domestic Electrical Equipment

Wash Boilers

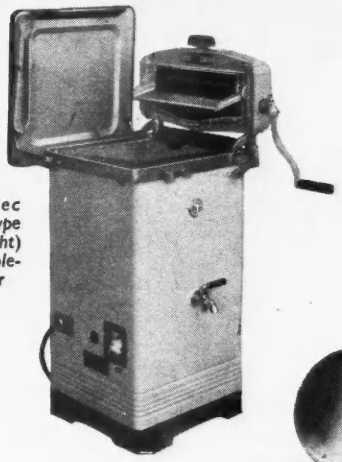
FOLLOWING our survey of washing machines we now turn to the subject of electric wash boilers, which are probably of equal importance as items of home laundry equipment, providing as they do a useful supply of hot water both quickly and conveniently for the many housewives who prefer to boil their clothes.

Both round and cabinet models are produced, several of the latter types being provided with castors for easier manœuvring. Many of the newer boilers have an improved appearance, in some cases being provided with a removable top which forms a useful additional table in the kitchen. Wringers and hand agitators are also available. The average capacity is in the region of ten gallons and the loading 3 kW. Most makers also supply an automatic cut-out device to safeguard the boiler should it be switched on when empty or be allowed to boil dry.

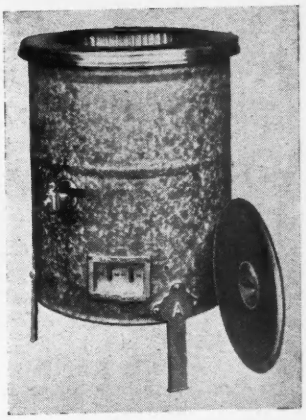
An addition to the Burco range is the "Baby Burco," a handy-sized 5 gal boiler with a spun aluminium container, while a newcomer to the wash boiler field is Vactric, Ltd., who recently introduced two new cabinet models one of which is supplied with a fold-in wringer and agitator.

Prices show a slight increase compared with a year ago, though wash boilers are not affected by changes in purchase tax, from which they are free.

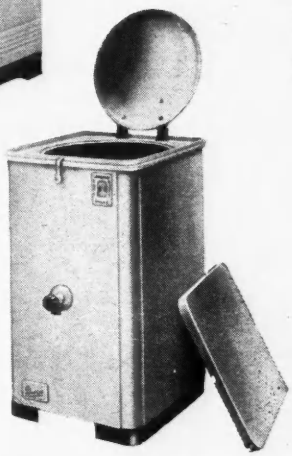
Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
ALDER ELECTRICAL APPLIANCES, LTD., Rushworth Street, Burnley, Lancs.	Alder "XR"	Round	27¾ × 19¾ diameter	10 gal	No	No	3 kW	3-heat, 2 foot-press switches
AMPLEC, LTD., Grange Works, Grange Lane, Accrington.	"Wringer Amplewash"	Cabinet	36½ × 18½ × 18½	10 gal	Yes (plus £1 7 4 purchase tax)	Optional extra	3 kW	Rotary 3-heat switch
	"Amplewash" Boiler	Cabinet	30 × 16½ × 16½	10 gal	No	No	3 kW	Rotary 3-heat switch
	"C.R.S."	Round	27½ × 17½ diameter	10 gal	No	No	3 kW	2 foot kick switches
	"R.J."	Round	27 × 16½ diameter	8 gal	No	No	3 kW	2 foot kick switches
BRADLEY & CO., LTD., Albion Works, Bilston, Staffs.	"Beldray" 329	Round	—	4½ gal	No	No	2 kW	Direct from plug. Cut-out
BRUNLEC APPLIANCES, LTD., Junction Mills, Junction Street, Burnley.	"600" Boiler/Wringer	Cabinet	30 × 17 × 17	10 gal	Yes (plus 18s 10d purchase tax)	Optional extra	3 kW	3-heat push-button switch
	"500"	Cabinet	30 × 17 × 17	10 gal	No	No	3 kW	3-heat push-button switch
	"540"	Round	27 × 19 diameter	10 gal	No	No	3 kW	3-heat foot-press switch
	"560"	Round	27 × 19 diameter	10 gal	No	No	3 kW	3-heat foot-press switch
BULPITT & SONS, LTD., Icknield Street, Birmingham, 18.	"600"	Round	—	4 gal	No	Percolating type turbulator	2 kW	Direct from plug
BURCO, LTD., Rose Grove, Burnley.	"Baby Burco" 761	Round	19¾ × 16 diameter	5 gal	No	No	2 kW	Direct from plug
	350F	Round	26½ × 16½ diameter	8 gal	No	No	2,625 W	3-heat foot-press switches
	375AS *(a)* and 600AS *(b)*	Round	28 × 17¾ diameter	10 gal	No	Agitator lid unit available £2 15 6 extra	3 kW	3-heat rotary switch
	E375AS *(a)* and E650AS *(b)*	Round	28 × 17¾ diameter	10 gal	No	Agitator lid unit available £2 15 6 extra	3 kW	3-heat rotary switch
	763DX	Round	31¾ × 19¾ diameter	16 gal	No	No	4½ kW	3-heat rotary switch
	E850AN	Cabinet	30½ × 17⅞ × 21¼	10 gal	No	Agitator lid unit available £2 15 6 extra	3 kW	3-heat hand-level switch
	E950AN	Cabinet	30½ × 17⅞ × 21¼	10 gal	Yes (plus £1 3 5 purchase tax)	Agitator lid unit available £1 16 7 extra	3 kW	3-heat hand-level switch
CHALFONT ELECTRICAL PRODUCTS, LTD., Tyrrell Street, Leicester.	"Popular"	Round	16 × 12 diameter	4 gal	No	No	2 kW	Direct from plug



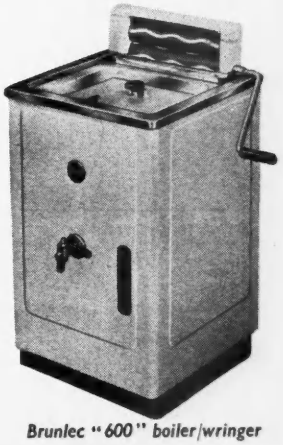
Left: Amplec "CRS" round type boiler and (right) "Wringer Amplewash" boiler



Alder "XR" wash boiler

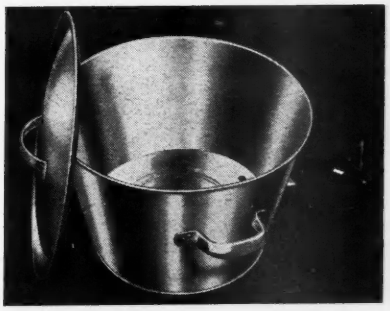


Right: Burco E.850 cabinet wash boiler



Brunlec "600" boiler/wringer

"Baby Burco" 5 gal boiler



Chalfont "Popular" wash boiler

Bulpitt "600" 4 gal boiler

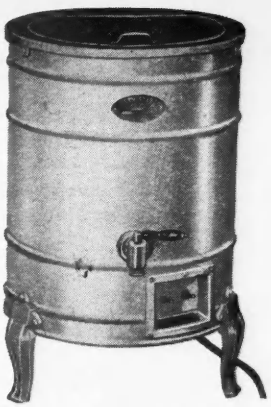
Bradley "Beldray" 329 4½ gal wash boiler

Exterior Finish	Tub Finish	Price
Galvanized	Heavily tinned	£8 15 0
Porcelain enamelled	Tinned copper	£24 10 0
Porcelain enamelled	Tinned copper	£15 15 0
Galvanized	Tinned copper	£9 12 0
Galvanized	Tinned copper	£8 17 6
Galvanized	Galvanized	£4 0 0
Cream or white vitreous enamel	Tinned copper	£22 10 0
Cream or white vitreous enamel	Tinned copper	£14 10 0
Grey, cream or white vitreous enamel	Tinned copper	£11 10 0 (cream or white) £11 0 0 (grey)
Galvanized	Tinned copper	£9 7 6
Galvanized	Galvanized	£6 10 0
Anodized aluminium	Anodized aluminium	£6 2 6
Galvanized	Tinned copper	£9 10 0
Galvanized	Tinned copper	£10 6 0 *(a)* and £11 12 0 *(b)*
Cream enamel *(a)* & white or cream enamel *(b)*	Tinned copper	£12 0 0 *(a)* and £12 12 0 *(b)*
Galvanized	Tinned copper	£19 15 0
White or cream enamel	Tinned copper	£17 10 0
White or cream enamel	Tinned copper	£25 0 0
Galvanized	Galvanized	£3 7 6

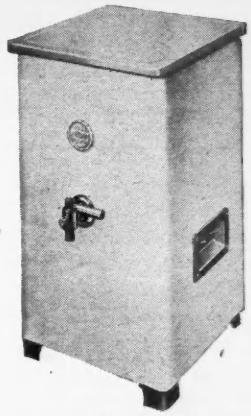
WASH BOILERS . . . . . *continued*

Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control	External Finish
DUGDALE MFG. CO., Craven Sheet Metal Works, Settle, Yorkshire.	39	Round	27×18½ diameter	8 gal	No	No	3 kW	3-heat press-button switch	Galvan
	40	Round	27×18½ diameter	8 gal	No	No	3 kW	3-heat press-button switch	Galvan
	41	Round	29×18½ diameter	10 gal	No	No	3 kW	3-heat press-button switch	Galvan
	42	Round	29×18½ diameter	10 gal	No	No	3 kW	3-heat press-button switch	Galvan
	43	Round	29×18½ diameter	10 gal	No	No	3 kW	3-heat press-button switch	Enam
	50	Cabinet	28½×17¼×17¼	10 gal	No	No	3 kW	3-heat press-button switch	Enam
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.	DE4753	Round	19×27 diameter	9⅛ gal	No	No	3 kW	2 d.p. switches	Galva
	DE4754	Round	19×27 diameter	9⅛ gal	No	No	3 kW	2 d.p. switches	Galva
	DE4755 and DE4755C	Round	19×27 diameter	9⅛ gal	No	No	3 kW	2 d.p. switches and cut-out	Galva (47 an enam (475
	DE4760	Cabinet	28×16⅜×16⅜	9⅛ gal	No	No	3 kW	2 d.p. switches and cut-out	Whit honey enam
L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, Kingsway, London, W.C.2.	"Dinky"	Round	12×10½ diameter	2¾ gal	No	No	1½ kW	—	Fro alumi
JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, London, S.W.1.	D.906	Round	27½×17¾ diameter	10 gal	No	No	3 kW	3-heat d.p. rotary switch	Galvan c white c enam
	907	Round	27½×17¾ diameter	10 gal	No	No	3 kW	2 d.p. switches and cut-out	Galvan c white c enam
LAMB, HINGLEY & CO., LTD., Lye, Stourbridge, Worcs.	"Apex" 436	Round	12½×15 diameter	4 gal	No	No	2 kW	Direct from plug	Galv
MONARCH ELECTRIC, LTD., Vicarage Road, Lye, Worcs.	"Handiwash" 788	Round	23×19 diameter	6 gal	No	No	2 kW	2-heat switch	Galv
NORTHERN INDUSTRIES, Snow Hill, Manchester, 4.	"Little Treasure"	Round	15½×10⅜ diameter	4½ gal	No	No	1½ kW	Direct from plug	Galv
SAMUEL SIMISTER & CO., LTD., Copper & Tin Works, Croston, Bolton.	"Standard"	Round	28×17½ diameter	10 gal	No	No	3 kW	2 foot-press switches	Galv
	"No. 7"	Round	24×15½ diameter	7½ gal	No	No	2 kW	2 foot-press switches	Galv
	"Competitor"	Round	28×17½ diameter	10 gal	No	No	2½ kW	2 foot-press switches	Galv
	"No. 5"	Cabinet	19×19×30	10 gal	No	No	3 kW	2 foot-press switches	Ena
HERMAN SMITH SMITHLITE, LTD., Empire Works, Dudley, Worcs.	G.1953	Round	26×17¾ diameter	10 gal	No	No	3 kW	3-heat rotary switch	Galv
	G.1953S.C.	Round	26×17¾ diameter	10 gal	No	No	3 kW	3-heat kick switch and cut-out	Galv
	E.1953	Round	26×17¾ diameter	10 gal	No	No	3 kW	3-heat rotary switch	Galv
	E.1953S.C.	Round	26×17¾ diameter	10 gal	No	No	3 kW	3-heat kick switch and cut-out	St ena
SOUTH WALES SWITCHGEAR, LTD., Blackwood, Mon.	350	Round	27½×18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches	Gal

Exterior Finish	Tub Finish	Price
Galvanized	Tinned	£11 0 0
Galvanized	Tinned	£11 4 0
Galvanized	Tinned	£12 0 0
Galvanized	Tinned	£12 4 0
Enamelled	Tinned	£13 0 0
Enamelled	Tinned	£17 0 0
Galvanized	Tinned	£9 17 6
Galvanized	Tinned	£10 5 0
Galvanized (4755) and enamelled (4755C)	Tinned	£11 5 0 (4755) £12 0 0 (4755C)
White or honeysuckle enamelled	Tinned	£16 0 0
Frosted aluminium	—	£3 15 0
Galvanized (*a*) or white or cream enamelled (*b*)	Tinned copper	£9 19 0 (*a*) £10 10 0 (*b*)
Galvanized (*a*) or white or cream enamelled (*b*)	Tinned copper	£11 4 0 (*a*) £11 15 0 (*b*)
Galvanized	Galvanized	£2 16 0
Galvanized	Galvanized	£5 18 0
Galvanized	Galvanized	£3 5 0
Galvanized	Tinned copper	£9 5 0
Galvanized	Tinned copper	£7 12 6
Galvanized	Tinned copper	£8 12 6
Enamelled	Tinned copper	£14 10 0
Galvanized	Tinned	£9 19 9
Galvanized	Tinned	£11 0 9
Galvanized	Tinned	£12 0 0
Stoved enamelled	Tinned	£13 1 0
Galvanized	Tinned	£9 5 0 (s.p. switches) £9 11 0 (d.p. switches) £10 10 0 (a.c. cut-out)



Simister "Standard" boiler

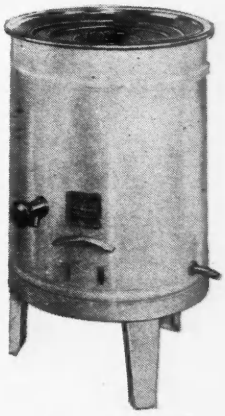


G.E.C. DE4760 cabinet wash boiler

Monarch "Handiwash" boiler

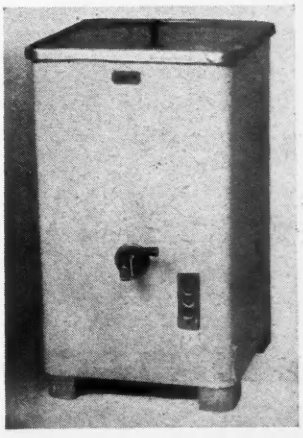
Hawkins "Dinky" wash boiler

Herman Smith, Smithlite round type boiler



Jackson "907" wash boiler

Lamb, Hingley & Co.'s "Apex" 4 gal boiler



Dugdale model 50 cabinet boiler

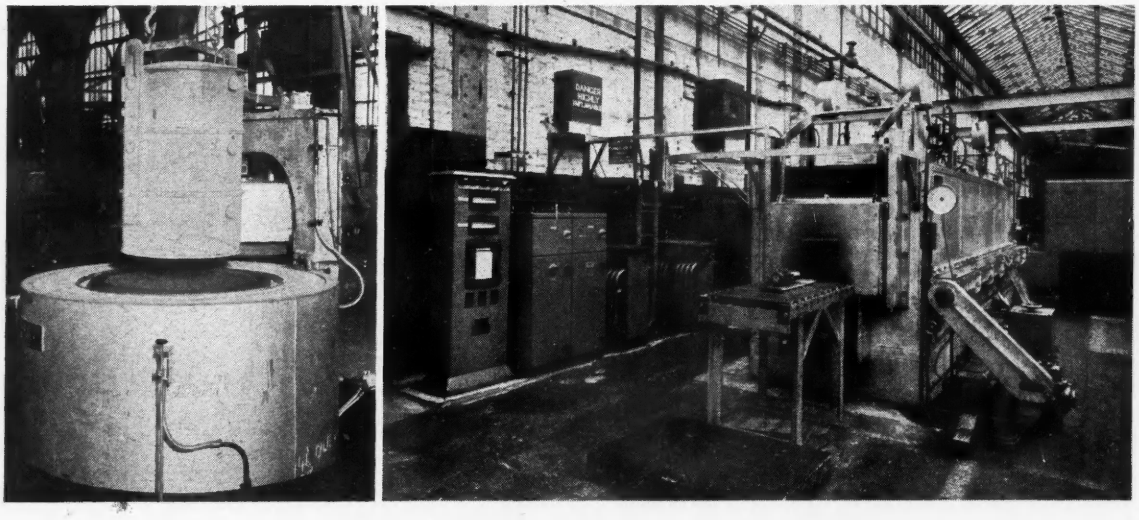
WASH BOILERS . . . . . *continued*

Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
SOUTH WALES SWITCHGEAR, LTD., Blackwood, Mon. *(continued)*	351	Round	27½ × 18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	352	Round	27½ × 18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
F. J. TOMLINSON, LTD., Hall Carr Mill, Rawtenstall, Lancs.	"Handy"	Round	12 × 15½ diameter	4½ gal	No	No	1½ kW	Ejector safety device
UNIVERSAL BOILERS & ENGINEERING CO., LTD. Fulledge Works, Burnley, Lancs.	RGAC	Round	28 × 19½ diameter	10 gal	No	No	3 kW	Rotary switch
	RGCO	Round	28 × 19½ diameter	10 gal	No	No	3 kW	2 foot-press switches and cut-out
	RSAC	Round	28 × 19½ diameter	10 gal	No	No	3 kW	Rotary switch
	RSCO	Round	28 × 19½ diameter	10 gal	No	No	3 kW	2 foot-press switches and cut-out
	SQAC	Cabinet	29½ × 16 × 16	10 gal	No	No	3 kW	Rotary switch
	SQCO	Cabinet	29½ × 16 × 16	10 gal	No	No	3 kW	2 foot-press switches and cut-out
VACTRIC, LTD., 196, Sloane Street, London, S.W.1.	V.77	Cabinet	30 × 18½ × 22	10 gal	Yes (plus 17s 9d purchase tax)	Optional extra	3 kW	3-heat switch. Cut-out if required
	V.45	Cabinet	30¼ × 16¾ × 20¾	9 gal	No	No	3 kW	3-heat switch. Cut-out if required

NEW GEAR HARDENING FURNACES

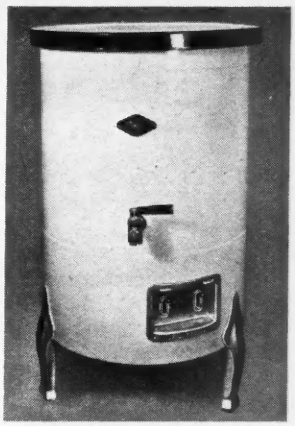
NEW electric furnaces recently installed at the Elswick and Scotswood Works of Vickers-Armstrongs (Engineers), Ltd., include two batch furnaces with separate cooling chambers, for gas carburizing gear wheels, and a continuous hardening furnace with a roller hearth. The processing or carburizing atmospheres are generated within the furnaces from a liquid mixture introduced by a drip feed technique. Inlets for the drip feed are in the roof of the furnace. The furnaces

Left: A nest of three work baskets containing gears being lowered into the drip feed 90 kW carburizing furnace at the Elswick Works and (right) the 100 kW roller hearth hardening furnace at the works of Vickers-Armstrongs (Engineers), Ltd.



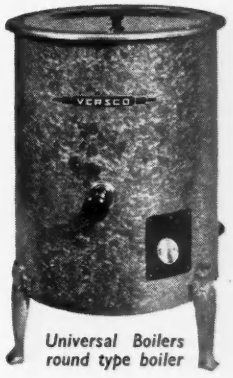
Exterior Finish	Tub Finish	Price
Cream or white stoved enamelled	Tinned	£11 3 0 (s.p. switches) £11 9 0 (d.p. switches) £12 8 0 (a.c. cut-out)
Cream or white stoved enamelled	Tinned	£12 6 0 (s.p. switches) £12 12 0 (d.p. switches) £13 11 0 (a.c. cut-out)
Galvanized	—	£3 9 6
Galvanized	Tinned copper	£11 11 0
Galvanized	Tinned copper	£12 18 6
Stoved enamel	Tinned copper	£13 5 1
Stoved enamel	Tinned copper	£14 12 7
Stoved enamel	Tinned copper	£17 1 0
Stoved enamel	Tinned copper	£18 3 0
White enamel	Tinned copper	£23 19 6
White enamel	Tinned copper	£13 19 6

Vactric model V.77 wash boiler with wringer attached



South Wales Switchgear "352" wash boiler

Tomlinson "Handy" boiler



Universal Boilers round type boiler

DRIP FEED TECHNIQUE FOR ATMOSPHERE

were designed and supplied by the General Electric Co., Ltd., who also developed the special fluid from which the atmospheres are obtained.

The carburizing furnaces are of identical design, each having a set of three baskets to carry the charge, with effective dimensions of 25in in diameter and 36in deep. Inside each furnace is a heat-resisting steel lining which is supported by a wide flange and is free to expand at the base with the increase in temperature. Round the outer periphery of the chamber is a sand channel in which rests the furnace cover lip to effect a gas tight seal. The bottom of the chamber extends into an oil sealing trough.

Each furnace is closed by an easily operated lift and the swing cover which has a leaf spring and a ratchet operated lifting lever. The cover is lined on the inside with heat resisting steel plate. It is centrally supported and can be rotated with tommy bars for bedding down in the sand.

The carburizing fluid is pumped to each furnace from its own storage tank and injected through an inlet in the lid. It drips on to a hot plate within the furnace chamber where it volatilizes. The atmosphere generated in this way is circulated rapidly round the charge by a centrifugal impeller situated beneath the stool which carries the baskets with its blades operating within the chamber.

The furnace elements are of heavy gauge nickel-chrome ribbon carried on the inner furnace lining and protected by the steel lining or chamber from the carburizing atmosphere. Each furnace has a maximum rating of 90 kW. The cooling chambers are of the same size and shape as the furnace chambers and are sealed in the same way with lift and swing type covers which rest in sand channels.

For partially cooling the gear wheels before transferring them to a cooling chamber, air can be admitted through port-holes in the lowest part of the furnace walls and allowed to circulate round the outside of the carburizing chamber. The gears are supported for carburizing on suitable jigs to minimize or eliminate distortion and are placed in the furnaces in baskets of heat resisting steel.

The carburizing gear wheels are subsequently case hardened by heating in the roller hearth furnace and quenching in oil under a press. The gears are inserted into the furnace on trays and are moved continuously along by the rollers which are driven by an induction motor through reduction gears. The time taken for the gears to pass through the furnace can be varied from 31 to 155 minutes, the actual time being shown on a tachometer mounted near the driving unit. As a charge approaches the exit end it breaks a beam of light falling on to a photo-electric cell and an alarm bell rings to warn the operator that a charge is ready to be removed.

The doors at both ends of the furnace are suitably counterbalanced and are operated hydraulically with foot controls. Cradles and idle rollers are provided to facilitate loading and unloading.

The complete furnace firing zone is 15ft long and it has a maximum rating of 100 kW. The heavy gauge nickel-chrome ribbon elements are mounted in the roof and in the hearth and arranged in two independently controlled sections. Both the gas carburizing furnaces and the roller hearth furnace are fitted with automatic temperature control and recording gear. They provide temperatures up to 1,000 deg C.

New Rating Assessments

INSPECTION OF LISTS — APPEALS PROCEDURE

By John C. Hancock*

NOTICES issued by the local rating authorities are now appearing in the provincial and national Press stating, among other things, that the new valuation lists are available for public inspection, and reminding ratepayers that they have a statutory right " at all reasonable times . . . to inspect and take copies of and extracts from . . . any valuation list."

Under the Local Government Act of 1948 the valuation of properties for rating purposes was transferred from local authorities to the Inland Revenue. The object of this was to obtain a uniform basis of valuation for factories, houses, commercial buildings and other hereditaments throughout the country. Whether that aim has been achieved or not does not come within the scope of this article though in passing one may be permitted to query whether two different establishments of more or less equal size and utility, situated respectively, say, in Birmingham or Barnstaple, could be accorded identical assessments, for the very reason that one happened to be situated in Birmingham and the other in Barnstaple.

A general revaluation for rating purposes is in any event long overdue, since the last valuation took place in 1934; the outbreak of war prevented the routine five-yearly valuation from taking place in 1939. The new valuation lists, due to come into force on 1st April next, will show a change in the basis of assessment. Whereas industrial buildings and commercial premises will be assessed on their current rental values, private dwelling houses, owing to the complications caused by rent restrictions, will be assessed by reference to 1939 values.

Industrial and Commercial Premises

The new lists prepared under the Act of 1948 have been given effect by the Rating and Valuation (Miscellaneous Provisions) Act, 1955. Neither of these Acts makes any radical changes in present practice. Agricultural land and buildings still remain completely de-rated and industrial hereditaments continue to be relieved of rates to the extent of 75 per cent of the net annual value. Above all, however, the fundamental " disincentive " to development remains, namely, the more that properties are improved the more the rating assessments are increased.

Even so, apart from any structural improvements which may have been made by the owners, the present revaluation will almost certainly impose on commerce and industry additional burdens. De-rated assessments are liable to go up by about 100 per cent while it is predicted that assessments of commercial premises may rise by anything from 100 to 300 per cent, or even more. Exactly what this will mean in terms of hard cash, or the amount of rates payable on such properties, cannot be ascertained until the rate poundages have been announced.

Possibly when the full financial effects are known the periodical agitation aimed at the repeal of the de-rating provisions contained in the Local Government Act, 1929, will cease, for a new class of favoured ratepayers will have been brought into existence, namely, the owners of residential property—which at present represents about 60 per cent of the total rateable value for England and Wales. As already stated dwelling houses will be assessed on their 1939 rentals, which in many cases will be purely hypothetical.

Anticipating that some ratepayers may feel " aggrieved " and may wish to appeal against their new assessments, the Ministry of Housing and Local Government, in a communication addressed to county councils and rating authorities in England and Wales (Circular No. 62/55) suggests that a notice should accompany the first demand notes for rates made by reference to the new lists, to the effect that if any ratepayer considers he has grounds for objecting to his new assessment he may make a proposal to alter it on or after 1st April, 1956. Ratepayers are, however, advised to wait until the rate poundage has been announced by the Council before deciding whether to make a proposal. " You will not be prejudiced by waiting until then " states the proposed notice. The notice goes on to say, among other things, that if there has recently been a physical change in the ratepayer's property, or a change in its use, the r.v. in the list may not be up to date and may be amended without notice before 1st April.

Appeal Procedure

If an " aggrieved " ratepayer serves, on the valuation officer, a proposal to reduce the new assessment during the rating year 1956/57 " the ratepayer cannot be required, before the proposal is settled, to pay more in rates in the first or any subsequent year after the revaluation takes effect than was payable in the last year before revaluation." In other words, if a ratepayer's demand for the current year (1955/56) is £350 and on his new assessment he is liable to pay £550 he is legally bound to pay the £350 even though he is appealing against the assessment. Naturally, if the appeal goes against him he will eventually have to pay the full amount demanded but while the appeal is pending the rating authority cannot institute proceedings with a view to recovering the amount in dispute.

Notices of appeal must be made on a prescribed form which may be obtained from the ratepayer's town hall or municipal offices. In passing, a proposal to have an assessment revised may be submitted at any time, but this cannot be done in respect of an assessment in the new lists until after 2nd April, 1956 (that date being Easter Monday). Briefly, a valuation officer can serve notice of an objection at any time within five months of the proposal being made; if the originator of the proposal does not withdraw it he will be assumed to be appealing against the objection, after which the case will go for hearing before the local valuation court. Any person who disagrees with a decision made by the local valuation court may appeal to the Lands Tribunal.

Bearing in mind the fact that factories, shops, offices and business premises generally are likely to have considerably increased assessments, electrical traders and manufacturers, as already stated, should remember that the full financial effects cannot be known until the rate poundages have been announced. Only in exceptional cases is it likely that rate poundages will be held at present levels. Indeed the Ministry of Housing and Local Government has advised the rating authorities that unnecessarily high rate poundages are likely to produce a spate of appeals, and this is the very thing which it is desired to avoid.

* Mr. Hancock is a member of the Finance Committee of Ealing Borough Council.

WORLD ELECTRICAL MARKETS

Swiss Industry and Trade

By R. E. KAAN, Dipl. Ing.

SWITZERLAND is a country in a special position, with an unbroken succession of prosperous years and the absence of inflation. Though placed on the traditional trade routes between east and west, north and south, and exposed to many economic currents, she is geographically isolated from the rest of Europe by the Alps, the Jura, and the Rhine. Lack of natural resources, with the exception of water power in abundance, forced this industrious people to employ the most modern manufacturing techniques, resulting in high productivity. Her industries, having been spared the ravages of two world wars, by her neutrality, markedly improved their position, and helped the country to attain what is probably the highest level of general prosperity in Europe.

As Switzerland lives largely by foreign trade, tourist traffic, and foreign investment, she is naturally at the mercy of fluctuations in the demand for the supply of goods and capital in foreign countries, over whose policy she has no control. The necessity for constant adjustment to changing external circumstances has engendered a certain toughness, aggressiveness, and vigilance in her business men.

Although certain Swiss electrical exports during the first ten months of 1955 declined, compared with the corresponding period of 1954, the total external electrical trade has steadily increased since 1952 and provides a reliable indicator of the country's prosperity (Figs. 1 and 2). The table shows the annual electrical exports by main markets.

Switzerland, in spite of being a small country, represents a highly selective quality market well worth cultivating for reasons of prestige as well as profit. Because of intense competition, articles, particularly domestic equipment, must be presented to appeal to Swiss taste as regards packing and finish.

SWISS ELECTRICAL EXPORTS BY SELECTED COMMODITY GROUPS AND MAIN MARKETS, 1953-54

Commodity group	Country	1953 £000	1954 £000
Motors, generators and transformers	Holland	427	501
	Finland	202	183
	Yugoslavia	173	204
	Egypt	283	216
	Iraq	2	8
	Israel	101	67
	India	286	302
	Pakistan	67	65
	Indonesia	69	150
	Canada	122	174
	U.S.A.	280	391
	Mexico	301	451
	Colombia	212	441
	Venezuela	73	196
	Brazil	520	619
	Uruguay	42	255
	Peru	193	215
	Australia	44	95
	Total to all destinations	9,021	10,271
Electrical control apparatus and instruments	France	210	282
	Yugoslavia	13	7
	Italy	293	280
	Holland	180	196
	India	93	75
	Pakistan	9	67
	Total to all destinations	2,250	2,390
Electric locomotives and components	France	263	56
	S. Africa	—	11
	Brazil	—	33
	French East Africa	57	12
	W. Germany	—	15
	Total to all destinations	3,510	1,351
Mercury arc rectifiers	Total	7,350	7,410
Cables and wires	Total	510	622
Telegraph and telephone app.	Total	590	1,240

Special functions relating to the import of certain electrical apparatus are exercised by the S.E.V. (Schweizer Elektrotechnischer Verein) in Zurich. Its testing regulations must be complied with in full to obtain its official sanction.

Western Germany and the United States are the keenest competitors of United Kingdom manufacturers, the former having the advantages of proximity, "Continental" mentality, similarity in design and excellent finish of electrical machinery, apart from the partly common language. With the exception of radio sets, refrigerators and washing machines represent the principal items of United Kingdom electrical exports to Switzerland. In 1954 the United Kingdom provided the following equipment (value in thousand £ sterling); the figures in parentheses show exports in the first ten months of 1955:—Steam and water turbines, 4·7 (7·4); generators, 7·8 (13·6); motors and parts, 101·1 (62·6); starting and control gear, 10·3 (3·1); switchgear and switchboards, 13·3 (1); welding electrodes, 11·2 (9); domestic appliances, 288·1 (403); scientific instruments and meters, 39 (49); X-ray apparatus and components, 11 (9); radio apparatus, 333 (175); total, including other items, 1,366 (1,088).

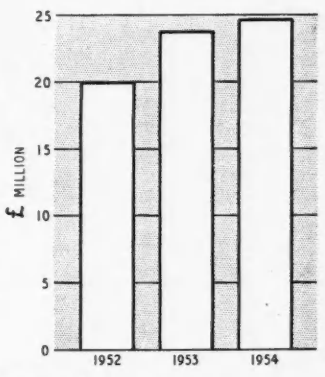


Fig. 1.—Swiss electrical exports 1952–54

American electrical exports to Switzerland in 1954 (in thousand £) were as follows:—Testing instruments, 74; household refrigerators, 151; fluorescent lamps, 57; washing machines, 74; other motor-driven household appliances, 103; medical X-ray apparatus and parts, 18; tape and other recorders, 52; ignition equipment, 20; total exports, including other items, 1,360; total exports January-August, 1955, 940.

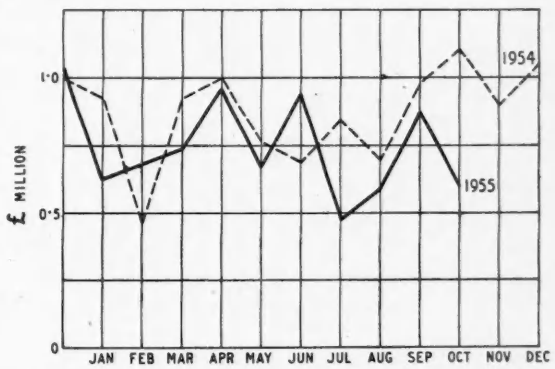


Fig. 2.—Exports of motors, generators and transformers, 1954–55

In 1954 Western Germany exported the following electrical goods to Switzerland (in £000):—Motors and generators, 512; water turbines, 231; switchgear, 138; electrodes, 433; household refrigerators, 342; telecommunication equipment, 2,231; domestic appliances, excluding refrigerators, 402; total exports, including items not listed above, 7,211; total exports, January-June, 1955, 3,751.

Within the Swiss industry by far the most important concern is Brown Boveri, of Baden, with subsidiaries in France, Italy, Norway, Canada and Brazil. Employing some 50,000 persons, this combine in common with other firms is self-financing, and has high standards of modernization and replacement. The manufacturing scope of this combine includes all kinds of heavy electrical plant and prime movers, gas turbines, axial flow blowers and turbochargers, betatrons for therapeutic purposes, and synchrotrons.

Reports from other firms like the Oerlikon Machine Works, the Ateliers de Constructions Mécanique de Vevey, and Escher Wyss Turbine Works, continue to show outstanding proficiency. This proficiency earns a regular income from goods manufactured under licence abroad. Because many overseas markets insist on at least partial construction of machinery within their own borders, about 28 per cent of Escher Wyss water turbines ordered during 1954 were made in the countries ordering them. This ensures full use of the company's overseas branches and associates in Germany, Italy, South Africa and the United States as a useful means of expanding sales.

The Swiss electrical industry counteracted the effects of price reductions forced on it by foreign competition by increasing production, though shortage of labour will limit future expansion of productive capacity.

In this crowded and highly selective market, used to a very high standard of service, the selection of a suitable agent is of paramount importance. Trade literature should be supplied in French or German or both, and should employ the metric system.

The Swiss market, despite its highly competitive character must remain one of the most valuable that any United Kingdom electrical manufacturer, taking a long view, can cultivate, particularly in the telecommunication and domestic appliance sections where the demand will considerably increase in the future. While the scope for the British manufacturer is growing, so is competition. In this market, particularly, the conditions of success can be summarized as follows:—Continued technical and commercial adaptability, pushing ahead with research in order to be in the vanguard with newer and more complex types of equipment, vigorous salesmanship based on competitive prices and shortest delivery times.

Lancashire Dynamo Group

AS we have already reported, Mr. H. W. Bosworth, A.M.I.E.E., has retired from the chairmanship of the Lancashire Dynamo Group and has relinquished his executive responsibilities after more than fifty years' service; he remains a director of the Group. Mr. Bosworth joined the Lancashire Dynamo Co. as a college apprentice and was successively technical engineer, London manager (1916), director (1924), joint managing director (1929) and managing director (1936-50). He had been chairman since 1945. Mr. Bosworth has been a member of the B.E.A.M.A. Council since 1940 and he was chairman in 1949-50.

Sir Percy H. Mills, Bt., K.B.E., is now chairman of the Group and Mr. S. F. Steward, C.B.E., has relinquished the chairmanship of the South Western Electricity Board to become managing director of the Group.

A dinner was held in London recently in honour of Mr. Bosworth. Sir Percy Mills presided and the company included the directors and senior executive officers of the company. Sir Percy Mills paid a tribute to Mr. Bosworth's great work for the company and for the electrical industry, describing him as one of the great salesmen of this country.

Mr. Bosworth in reply expressed his gratitude to the staffs of all the companies in the Group at home and abroad for all they had done. He saw a great future for the Group in the years ahead and thought they were fortunate to have men of the calibre of Sir Percy and Mr. Steward to lead them on to greater heights.

Sir Percy Mills introduced Mr. Steward, who welcomed the opportunity of meeting his future colleagues and said that he came with high hopes for the continued success of the Lancashire Dynamo Group with its good resources, great reputation and wonderful prospects. It was the function of the Holdings Company to ensure that the potentialities and enterprise of the individual companies were exploited to the full in the interests of the Group as a whole.

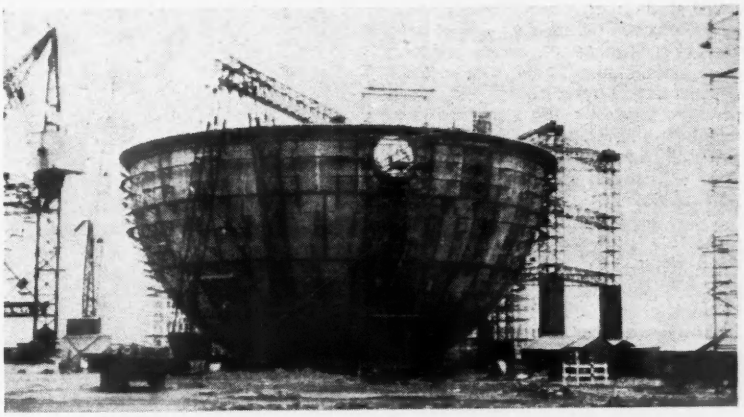
A presentation to Mr. Bosworth was made on behalf of the company present by Mr. H. Eaton, of the Trafford Park Works of Lancashire Dynamo & Crypto, Ltd., who was able to look back on as long a period of service with the company as Mr. Bosworth.

At the Lancashire Dynamo Group dinner: Sir Percy Mills, Mr. H. W. Bosworth and Mr. S. F. Steward

I.E.E. Benevolent Fund

Sir George Nelson, Bt., President of the Institution of Electrical Engineers, has made an appeal for greater support to the Institution's benevolent fund in which he says that during the year ended 30th June last grants were made to 133 beneficiaries amounting to £9,092. This was possible through the generosity of past members and the help of about one-third of the present members to the fund. Support from the remaining two-thirds of the members would mean that it would be possible to provide further assistance which is really necessary to relieve adequately the misfortunes of the less fortunate professional colleagues. He asks all members to support the fund this year, and thus ensure that the income will be more than sufficient to give adequate relief to all deserving cases and that the homes fund at least reaches the target aimed at. Through the medium of the homes fund the Institution has been able to complete two-thirds of the development of "The Chesters" estate. The amount subscribed, or promised, however, is only £43,000 towards the set target of £50,000 and is therefore £7,000 short.

GENERATION AND DEVELOPMENT



Present state of construction of the reactor sphere at the Dounreay nuclear power station

The Dounreay Sphere

The sphere which is to house the experimental fast breeder reactor at the Dounreay power station of the United Kingdom Atomic Energy Authority is being built by the Motherwell Bridge & Engineering Co., Ltd., to a very high standard of welding which has entailed extensive radiography of weld seams. The welded steel sphere is to be 135ft in diameter. The Motherwell Company appointed Welding Supervision, Ltd., to expedite and supervise the radiography on the welding work on the sphere, and up to the present time about 5,000ft of heavy section plate welding has been radiographed to the satisfaction of Lloyd's senior resident surveyor. Portable 250 kV X-ray sets have been used, and the supervision service has been integrated and closely controlled with the main radiographic unit. In spite of the inclement weather and the unusual nature of the work, the radiographic inspection has been carried out smoothly.

New Scottish Hydro-Electric Stations

The North of Scotland Hydro-Electric Board has brought into commission the Quoich power station in Inverness-shire and the first machine of the Errochty power station in Perthshire.

Quoich is the upper station of the Board's Glen Garry hydro-electric scheme; it houses a 30,000 b.h.p. turbine directly coupled to an alternator rated at 22,000 kW. The turbine is fed through nearly three miles of tunnel by water impounded in the reservoir formed by raising the level of Loch Quoich. A rock-fill dam, 1,000ft in length and 122ft to spill level, the largest in Great Britain, has been built at the east end of the loch and two concrete gravity dams at the watershed prevent water spilling down to the west coast.

The Errochty power station when fully commissioned will have three 25,000 kW sets operating under a gross head of 610ft. A six-mile tunnel connects the power station to Loch Errochty, a new loch which has been formed by a dam in Glen Errochty near Trinafour. This dam is a diamond headed buttress structure, 1,310ft long and 127ft high and although not yet completed, is collecting storage for the operation of the generating plant. The station building, set back in a quarry-like excavation, is faced with variegated stone dug out of the tunnel.

The civil engineering consultants for the Garry scheme are Sir William Halcrow & Partners, the electrical consultants are Messrs. Kennedy & Donkin, and the main civil engineering contractors for the Quoich works are Richard Costain, Ltd. The civil engineering consultants for the Errochty section of the Tummel-Garry scheme are Sir Alexander Gibb & Partners, the electrical consultants are Messrs. Merz & McLellan, and the main civil engineering contractors are A. M. Carmichael, Ltd. The turbines at both stations were manufactured by John Brown & Co. (Clydebank), Ltd., for Boving & Co., Ltd., the alternators at Errochty being made by the General Electric Co., Ltd., and that at Quoich by Harland & Wolff for the English Electric Co., Ltd.

Wakefield "B" Power Station

The first 60 MW set at the new Wakefield "B" power station of the Central Electricity Authority's Yorkshire Division was commissioned a few days before Christmas. Work was begun on the site preparation for this £12 million station in June, 1952, and the project is expected to be completed in about a year. The station will have an ultimate installed capacity of 240 MW.

Suggested Nuclear Station Site

The *Express and Echo*, Exeter, reports that the Central Electricity Authority is to study a proposal by the Plymouth Chamber of Commerce that an experimental nuclear power station should be built near the mouth of the River Erme.

Farmers and Electricity

Addressing members of the Pickering (Yorks) Branch of the National Farmers' Union, Mr. T. M. Ayres, chairman of the North Eastern Electricity Board, referred to the great strides which had been made since vesting day in the supply of electricity to rural areas, but he urged farmers to make a greater use of the service. To-day, out of a total of 210,000 rural premises in the Board's area, about 85 per cent had electricity supplies, including 9,400 farms (against 4,200 before nationalization). The remaining 15 per cent were in remote areas and the Board would either have to ask for bigger capital contributions or persuade farmers to use more electricity. He thought that the latter plan was the right one, and he suggested that farmers should make greater use of the Board's Advisory Service which would give them information on making the best use of electricity. At present they spent an average of about £30 per annum on electricity, but the cost of supplying each farm averaged £500. The position at present was that farmers were being subsidized by other consumers.

New Dublin Set in Operation

The second of the three 30,000 kW generating sets in the Irish Electricity Supply Board's power station at Ringsend, Dublin, is now erected and began to supply electricity to the national network on a test run recently. The third set is due for commissioning next autumn.

Domestic Appliances Given to Tenants

Because Brighton Housing Committee does not wish to remain responsible for maintenance owing to the increasing cost, 3,000 wash-boilers and 2,500 portable electric fires in Council houses are to be given to the tenants.

Merseyside and N. Wales Sales

Figures announced by the Merseyside and North Wales Electricity Board show that the sales of electricity during 1955 increased by 12 per cent over the previous year to a record total of 4,000 million kWh. This increase, due largely to additional industrial activity in the area, is considerably higher than the national average. The greater purchasing power of the public was reflected in the Board's sales of elec-

trical appliances, which rose in value by £500,000 to nearly £2 million. During 1955 some 30,000 new premises were connected. This figure includes approximately 1,700 farms and 26,000 private houses. To provide new supplies and reinforce existing networks "Manweb" laid 839 miles of new mains and commissioned 1,426 new substations.

Blaenau Festiniog Station Design

Sir Patrick Abercrombie, consultant to the Snowdonia Park Joint Advisory Committee, told members at Dolgelly recently that he had agreed to the choice of architect to design the new power station at Blaenau Festiniog, which is included in the Central Electricity Authority's £14 million hydro-electric scheme. He is Mr. Leslie Gale, whose design for the power station at Castle Donington was shown in last year's Royal Academy. The appointment of a landscape consultant has yet to be announced.

Acquisition of Australian Undertaking

Mr. Justice Sugerman, in the Land and Valuation Court, Sydney, on 19th December announced the highest compensation award ever made by an Australian Court—£2,400,000. This amount is to be paid by the State Electricity Commission for its acquisition of the Electric Light & Power Supply Corporation, Ltd. The award, however, was not as high as some people had predicted, and after the Court announcement shares in the Corporation dropped 15s to 47s on the Stock Exchange, having jumped 8s 6d to 62s earlier in the day.

Mr. Justice Sugerman made the award in a reserved judgment after a hearing which lasted from September, 1954, to June, 1955. When the Corporation was acquired by the Commission the Court was asked to assess proper compensation. The Corporation originally claimed £10,000,000, while the Commission put the amount at £1,700,000. At the conclusion of evidence these figures were modified to £8,000,000 and £1,900,000, respectively. On behalf of the Commission it was contended that the basis of computation should be the capitalized value of the profits. On the other hand the Corporation argued that the compensation payable by the Commission should be the replacement value of its assets, less proper depreciation.

His Honour, in his judgment, accepted substantially the basis of assessment put forward by the Commission. He allowed three months for appeal.

Large N.S.W. Project

The State Electricity Commission of New South Wales is to build a new power station near Newcastle at a cost of £A65 million. It will have a capacity of 1,000 MW.

Fluorescent lighting in Kensington Road, Westminster. Mazda 5ft lanterns, each housing four 80 W lamps, are mounted at a height of 25ft

STREET LIGHTING NOTES

The Minister of Housing and Local Government, Mr. Duncan Sandys, has informed ETON U.D.C. that it must apply for planning permission before continuing with its scheme, already approved by the Ministry, for lighting the main Windsor to Slough road. The proposal has been the subject of considerable controversy between the U.D.C. and Eton College over the form of lighting to be used. The Council has decided to let the lighting contractors proceed with the work where the school buildings are not affected.

At a ceremony in KEIGHLEY recently the Mayor (Ald. P. Taylor) formally switched on over 30 fluorescent street lamps to serve part of the town centre. This represents the first instalment of a scheme for relighting the trunk road with mercury vapour lamps from Victoria Park to the borough boundary at Utley, and with fluorescent lighting from Dalton Lane to Spring Gardens Lane.

The acceptance of the tender of the Metropolitan-Vickers Electrical Co., Ltd., of £20,380 for the re-lighting of the district and the South Eastern Electricity Board's quotation of £14,072 for providing all services and additional cables required, is recommended by the WALTON and WEYBRIDGE Highways and Lighting Committee.

Fluorescent lighting has recently been installed in Kensington Road and Knightsbridge, west of Albert Gate, by the WESTMINSTER City Council. This is the second fluorescent street lighting scheme carried out by Westminster Council, the first being a pioneer B.T.H. installation in Bond Street in 1946. For the present scheme 80 Mazda 5ft lanterns, each housing four 80 W lamps, have been mounted at a height of 25ft, either singly or in pairs. Specially designed steel columns with ornamental cast-iron sleeves have been used, placed both centrally and at the kerbside.

An illumination of 11,000 lumens per 100ft of roadway has been achieved and this may be compared with the 7,000 lumens recommended as the normal maximum for ordinary main road lighting in the B.S. Code of Practice.

BRENTFORD and CHISWICK Works and Highways Committee has recommended the Council to proceed with the conversion of street lighting in Brentford from gas to electricity which is estimated to cost £100,000.

NEWCASTLE-ON-TYNE City Council has received loan sanction for £37,765 which is the cost of the first year's programme in connection with the conversion of street lighting from gas to electricity.

The borough engineer of GATESHEAD has prepared plans for the fourth stage of the Town Council's scheme for converting the street lighting from gas to electricity. The cost will be about £26,000. The approval of the Ministry of Transport is being sought.

HARTLEPOOL Town Council is seeking sanction to borrow £7,112 for street lighting in Hart Road and West View Road.

ST. HELENS Lighting Committee has submitted to the Ministry of Transport a lighting scheme for the Marshalls Cross Road district, estimated to cost £13,500.

RICHMOND (Yorks) Town Council is to carry out an electric street lighting scheme involving the erection of 111 sodium lamps of 60 and 140 W.

YEOVIL Borough Council has decided to complete the electrification of public street lighting in the town in one stage instead of by instalments. The estimated cost of the whole work is £29,934.

WHITBY (Yorks) R.D.C. has accepted an estimate submitted by the North Eastern Electricity Board of £1,683 for the provision of another 63 street lamps in the rural area.

Improved street lighting at TONBRIDGE is estimated to cost about £4,000.

Further street lighting improvements are to be carried out at WELLINGBOROUGH at an estimated cost of £9,390.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 9th January

BIRMINGHAM. — Imperial Hotel, 6 p.m. I.E.E. South Midland Supply & Utilization Group. "Supervisory Equipment for the Indication of Shaft Distortion in Steam Turbines," by D. Antrich, H. W. B. Gardiner and R. K. Hilton and "The Electrical Measurement of Steam Turbine Rotor Movements, with special reference to the Operation and Design of Modern Power Plant," by J. L. Ashworth, J. S. Hall and A. H. Gray.

BRISTOL. — Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Centre. "Standardization of Retail Electricity Tariffs," by A. O. Johnson and N. F. Marsh.

DUNDEE.—Royal British Hotel, 7.30 p.m. Institution of Engineering Inspection, East of Scotland Branch. "Radar."

HULL.—Y.E.B., Ferensway, 7 p.m. I.E.S. Leeds Centre. "Street Lighting," by J. J. French.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. "Power Cable Manufacture and Design," by N. Hewett.

Hotel Metropole, King Street, 7 p.m. Institution of Production Engineers, East & West Ridings Region, Yorkshire Section. "Automatic Inspection—The Anatomy of Conscious Machines," by J. A. Sargrove.

LEICESTER.—Demonstration Theatre, Electricity Offices, Charles Street, 6.45 for 7 p.m. Leicester Electrical Society. "Uses of Electricity in Physical Treatment," by Dr. N. R. W. Simpson.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. Informal meeting. Discussion on "The Efficient Use of Technical Personnel," opened by the President.

St. Ermins Hotel, Caxton Street, 7 p.m. A.S.E.E. Central London Branch. A.S.E.E. Exhibition film.

Caxton Hall, S.W.1, 7 p.m. E.P.E.A., London Technical Group. "A New Concept of Frequency Control," by A. W. Dunbar.

MANCHESTER.—Nag's Head Hotel, Jacksons Row, 7 p.m. Electrical Trades' Commercial Travellers' Association, North Western Branch. General meeting, followed by film and lecture by J. Eddyshaw.

NEWCASTLE-UPON-TYNE. — Neville Hall, 6.15 p.m. I.E.E. North-Eastern Centre. "A Criterion of Distribution Cost," by D. J. Bolton.

County Hotel, Neville Street, 6 for 6.30 p.m. North East Electrical Club. "Mineral Insulated Cables," by G. F. Hewitt.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. "Modern Telephony," by C. E. Hay.

WALSALL.—Technical College, Wisemore, 7.15 p.m. Ministry of Works, Walsall Branch. "Latest Techniques for Electrical Installation in Small Buildings," by G. A. Wedge.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North-West London Branch. "Power Factor Correction," by F. Guess.

Tuesday, 10th January

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "The Electrification of the Manchester-Sheffield-Wath Lines, Eastern and London Midland Regions, British Railways," by J. A. Broughall and K. J. Cook.

BOURNEMOUTH. — Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth Branch. "Installation Testing," by S. Potter, and "Meters and Metering," by H. F. Miles.

CHELMSFORD.—Public Library, 7 p.m. I.E.E. London Graduates' & Students' Section, district meeting. "An Introduction to the Transistor," by A. V. Bryant.

EDINBURGH.—11, Atholl Crescent, 7.30 p.m. Edinburgh Electrical Society. "Productivity," by A. Robertson, and "Capacitors Pay Dividends," by I. O. Stewart.

25, Charlotte Square, 7 p.m. Incorporated Plant Engineers, Edinburgh Branch. "Materials Handling," by J. Findlay.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Graduates' & Students' Section. Main Centre Chairman's Address, by F. Barrell.

LONDON.—Savoy Place, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Teaching Electrical Engineering to Mechanical Engineering Students," opened by H. E. Dance. (Joint meeting with the Education Group of the Institution of Mechanical Engineers.)

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club luncheon. Speaker: Sir Graham Hayman, president, F.B.I.

LUTON.—Midland Hotel, Williamson Street, 8 p.m. A.S.E.E. Luton Branch. "Electronic Motor Control," by C. Coates.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Supply Group. "Flat Pressure Cable," by J. S. Mollerhoj, A. M. Morgan and C. T. W. Sutton.

Engineers' Club, Albert Square, 7.15 p.m. Incorporated Plant Engineers, Manchester Branch. "Power Factor Correction."

NOTTINGHAM.—College of Art and Crafts, 6.30 p.m. I.E.E. East Midland Centre. "The Standardization of Retail Electricity Tariffs," by A. O. Johnson and N. F. Marsh.

PRESTON.—Bull & Royal Hotel. Institution of Works Managers, Preston Branch. Annual dinner.

STOKE-ON-TRENT. — I.E.E. North Staffs. Students' Section. Senior Chairman's Address, by Dr. E. R. Patrick.

Wednesday, 11th January

BIRMINGHAM.—James Watt Institute, 6.30 p.m. I.E.E. South Midland Students' Section. Students' Lecture: "Communication of Information, Human, Animal and Machine," by Dr. E. C. Cherry.

Chamber of Commerce, New Street, 6.30 p.m. A.S.E.E. Birmingham Branch. Discussion of Association and Exhibition matters with the general secretary, Mr. E. A. Bromfield.

CHATHAM.—Sun Hotel, 7.45 p.m. Institute of Welding, Medway Section. "Through the Welding Arc," by W. K. B. Marshall.

EDINBURGH. — Y.M.C.A. Hall, 14, St. Andrew's Street, 6.15 p.m. I.E.S. Edinburgh Centre. "The Lighting Engineer," by G. E. L. Comrie.

FARNBOROUGH.—R.A.E. Technical College, 7.30 p.m. I.E.E. Southern Centre. Discussion on "The Applications and Limitations of Electronic and other Computers," opened by Dr. L. G. Brazier.

HALIFAX.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. "Power Factor Correction," by A. Brecknell.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Radio and Telecommunication Section. "Pulse-Time-Modulation Terminals, for Music Transmission over Radio Links," by R. F. Rous.

At the Royal Society of Arts, John Adam Street, 6.45 p.m. Institution of Engineering Inspection. "Testing Gear for Inspection of Services Electronic Equipment."

MIDDLESBROUGH.—Cleveland Scientific & Technical Institution, Corporation Road, 7.30 p.m. Society of Instrument Technology, Tees-Side Section. "Sizing of Control Valves," by A. W. Morrison, "Testing and Inspection of Control Valves," by S. Fisher and "Servo-Motors for Control Valve Operation," by H. Forrester.

NEWCASTLE-UPON-TYNE. — Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North-Eastern Section. "Some Interference Problems Associated with the Television Service," by J. C. Belcher.

NORTHAMPTON.—College of Technology, 7.15 p.m. Northampton & District Electrical Association. "Industrial Application of T.V.," by B. V. Somes-Charlton.

OXFORD.—37, George Street, 7 p.m. I.E.E. district meeting. "Atomic Energy Programme," by R. A. Peddie.

PRESTON.—19, Friargate, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "A Transatlantic Telephone Cable," by Dr. M. J. Kelly, Sir Gordon Radley, G. W. Gilman and R. J. Halsey.

WIMBLEDON.—Guild House, 32, Worple Road, 8.15 p.m. A.S.E.E. South-West London Branch. Branch lecturettes.

WOLVERHAMPTON — Wolverhampton & Staffordshire Technical College, Wulfruna Street, 7.15 p.m. British Institution of Radio Engineers, West Midlands Section. "Computer Control of Machine Tools," by H. Ogden.

Thursday, 12th January

CARDIFF.—Institute Buildings, Park Place, 6 p.m. South Wales Institute of Engineers. "Electronics," by Prof. Emrys Williams.

CARLISLE.—Technical College, 7 p.m. I.E.E. North-Eastern Centre, district meeting. "New Lamps, New Uses and New Lighting Techniques," by R. V. Mills.

GLASGOW.—39, Elmbank Crescent, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Peaceful Uses of Atomic Energy," by Dr. K. G. McNeill.

LIVERPOOL.—At the Royal Institution, Colquitt Street, 7.15 p.m. Incorporated Plant Engineers, Merseyside & North Wales Branch. "Radiography in Industry," by E. J. Grimwade.

NEWCASTLE-UPON-TYNE.—Roadway House, Oxford Street, 7 p.m. Incorporated Plant Engineers, North East Branch. "The Gas Turbine in Industry," by J. R. Needham.

Carliol House, 3 p.m. E.I.B.A. Northern Counties Area. Annual general meeting.

SWANSEA.—S. Wales Electricity Board's Conference Room, The Kingsway, 6 p.m. I.E.E. West Wales (Swansea) Sub-Centre. "Electrolytic Processes for Surface Conditioning of Metals," by Dr. J. W. Cuthbertson.

Friday, 13th January

BIRMINGHAM.—Queen's Hotel. I.E.S. Birmingham Centre. Annual dinner.

CREWE.—Royal Hotel, 8 p.m. A.S.E.E. Stoke & Crewe Branch. "Heating and Ventilating."

IPSWICH.—Diocesan Hall, Tower Street, 7.30 p.m. Institution of Production Engineers, Eastern Region, Eastern Counties Section. "Factory Electrical Layout and the Production Engineer," by C. A. Marriott, "A Special Tapping Machine," by L. A. Childs, and "Flaw Detection," by E. J. Cove.

LONDON.—Caxton Hall, S.W.1, 6.30 p.m. E.P.E.A. Southern Meter Engineers' Group, "Planning and Organization of a Central Testing Station," by W. J. Jefferson.

I.E.E. North-Western Centre

The annual dinner of the North-Western Centre of the Institution of Electrical Engineers will be held on 13th March at the Midland Hotel, Manchester. Sir George Nelson, Bt., President I.E.E., will attend, and the dinner will be followed by an informal reunion. Applications for tickets (£1 7s each) should be made by 31st January to Mr. T. T. Evans, hon. secretary, 9, Kingston Drive, Sale, Ches.

Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets made a quiet entry into the New Year. They normally expect a certain amount of selling of securities in order to meet tax liabilities at this season, and were prepared for the volume to be somewhat larger this time, because of the overdraft restrictions. Moreover, the opening moves connected with the engineering trade unions' £150 million wage claim drew attention to one of the major uncertainties in the early investment prospect. Nevertheless, there has been little evidence so far of any marked change in the conditions prevailing in the closing months of 1955, a feature of which was the obvious determination of investors not to be dislodged from their holdings of good industrial shares.

Rise in E.M.I.

Price changes over a period of three weeks are covered, on this occasion, in the accompanying share tables. They show that the 10s shares of Electric & Musical Industries started this year in particularly good form: the shares have risen about 8s since before the annual meeting, at which the chairman's review of the group's activities left favourable impressions. Chloride Electricals, with a rise of 5s 6d, were almost equally prominent. An improvement of 4s 9d in R. A. Listers reflects the good annual results reported by the company, and Plesseys were again well supported. Hall Telephones, which gave one of the best market performances of 1955, continued upward to 34s. Westinghouse Brakes were changing hands up to £5 in advance of the final dividend declaration. Deccas also were firm and active while awaiting that company's results.

Hackbridge Cable

As previously noted here, the 5s ordinary shares of Hackbridge Cable Holdings achieved distinction by finishing last year at around the highest point registered during the twelve months. A report issued by one of the principal Stock Exchange dealers in the shares makes an important point of the company's acquisition last year of the Bryce and Siemens-Schuckert unit. Only a very small proportion of the profits earned by this unit were available, they say, for dividend purposes last time. Taking into account the pre-acquisition profits of the Bryce group, it is calculated that the group's earnings in 1954–55 were equivalent to 116 per cent on the ordinary capital, or more than four-and-a-half times the rate of the 25 per cent dividend. In August, the annual report spoke well of trading results up to that time. An interim dividend on account of the year ending next March is due about now.

Hoover Scheme

Market opinion looks to see agreement upon the revised plan, now

Three Weeks' Price Changes

Company or Board	Nom. Value	Middle price 2nd Jan.	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	80½		3	3	3 14 6	94¾	76½
Brit. Elec. 1974/77	100	79½		3	3	3 15 6	93½	75½
Brit. Elec. 1976/79	100	83½		3½	3½	4 3 9	98¾	80½
Brit. Elec. 1974/79	100	94½	−1	4¼	4¼	4 10 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	20/9		6†	6†	5 15 9	22/6	20/9
East African Power	£1	20/-	−1/-	7	7	7 0 0	24/6	19/9
Nigerian Elec.	£1	21/6		10	10	9 6 0	27/-	21/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	22/9	21/-
Perak Hydro-Elec.	£1	17/6		10	10	—	22/3	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/9	−3d	12½	17½	6 17 3	14/6	11/-
Aerialite	1/-	6/6	−3d	88½	45*	6 18 6	6/9	5/3
Allen, W H.	£1	75/9	+1/3	20	20	5 5 6	83/9	74/6
Aron Elec. Ord.	£1	55/6		15	15	5 8 0	63/9	55/6
Assoc. Elec. Ord.	£1	83/9	−1/3	11½	14	3 11 5	96/-	62/6
Automatic Tel. & El.	£1	70/9	+2/-	15	15*	4 4 9	79/6	60/-
Babcock & Wilcox	£1	83/9	+1/3	12*	15	3 12 0	98/-	68/6
Baldwin, H.	2/-	5/-		20	20	8 0 0	5/6	4/4
Bakelite	10/-	33/6	+6d	12½	16	4 15 6	34/6	27/-
British Aluminium	£1	52/6	−2/-	10	12	4 11 6	58/-	35/3
B.I. Callender's	£1	53/-	+6d	10	12½‡	4 14 3	55/3	44/9
B.I. Callander's 6% Pref.	£1	22/6		6	6	5 6 9	26/6	21/9
British Thermostat	5/-	31/3		27½	27½	4 8 0	35/-	22/6
British Vac. Cleaner	5/-	8/6		25	30	—	10/-	6/6
Brook Motors	10/-	45/6		20	25	5 10 0	47/-	39/9
Brush Ord.	5/-	7/3	−3d	6	10	6 18 0	9/6	7/6
Bulgin, A. F.	1/-	7/-		30	45	6 8 6	8/-	4/-
Burco Dean	5/-	12/6		—	—	—	17/3	12/-
Chloride El. Storage	£1	73/-	+5/6	12½	17½	4 16 0	77/6	58/6
Clarke Chapman	£1	96/3	+1/3	20	20*	4 3 0	102/6	68/9
Cole, E. K.	5/-	22/-	+3d	27½	17½*	3 19 6	25/6	18/3
Cossor, A. C.	5/-	10/-	+3d	10	15	7 10 0	14/-	8/9
Crabtree	10/-	29/-	+6d	20	20	6 18 0	34/6	27/6
Crompton Parkinson Ord.	5/-	15/-		20	16*	5 6 8	19/9	15/-
De La Rue	5/-	20/3	−9d	20	30	7 8 2	26/-	17/-
Decca	4/-	44/6	+1/3	35	56¼*	—	48/9	31/-
Desoutter	5/-	32/6	+1/3	20	25	3 17 0	35/-	25/6
Dewhurst	2/-	12/-	+1/-	24	30	5 0 0	11/3	7/3
Dictograph Tel.	2/-	7/-	−3d	20	20	5 14 3	9/3	6/6
Dubilier Condenser	1/-	4/6		25	25*	5 11 0	5/7	3/1
E.M.I.	10	36/3	+7/9	10	15	4 2 9	37/-	25/3
Electrical Components	5/-	15/-		20	25	8 6 8	21/3	13/9
Elec. Construction	£1	29/9		15	8½	5 14 3	41/3	28/9
Enfield Cable Ord.	£1	19/-		Nil	Nil	Nil	25/3	18/6
English Electric	£1	65/-	−6d	10	12½	3 17 0	86/9	54/3
English Electric 3½% Pref.	£1	14/6		3½	3½	5 3 6	16/9	14/-
Ericsson Tel.	5/-	42/6	−2/6	25†	25*†	2 18 9†	46/6	29/-
Ever Ready	5/-	32/6	−6d	40	35*	5 7 9	38/-	22/3
Falk Stadelmann	£1	46/3		15	17½	7 11 3	52/6	42/-
G.E.C. Ord.	£1	62/6	−2/-	12½	14	4 9 6	80/3	51/3
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 6	28/4	23/6
General Cables	5/-	16/9		30	30	8 19 0	17/-	15/-
Greenwood & Batley	£1	47/6		17½	17½	7 7 4	57/6	45/-
Hackbridge Cable	5/-	23/9		20	25	5 5 3	23/9	14/-
Hackbridge & Hewittic	5/-	20/9		25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	34/-	+2/6	10	10	2 18 9	32/-	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	17/3		10½	10½	6 1 9	21/3	15/9
Holophane	5/-	18/9		25	30	8 0 0	19/9	16/-

* After scrip issue. † Free of income tax. ‡ Dividend forecast.
The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

before the Hoover company's shareholders, for extinguishing the special rights of the "A" ordinary shares. It gives better terms than those originally offered to holders of the latter, who would now receive 135 (instead of 115) new 5s "A" ordinary, plus ten 5s ordinary shares, for every 100 of the existing "A" ordinary. The new shares would rank equally with the ordinary for dividends; and, on the basis of estimated profits and distributions for the current year, holders of both classes would receive in dividend about the same amount as they would be entitled to under present arrangements. The scheme will come up for consideration at a meeting on 11th January.

Figures given by the Hoover Company in connection with the new capital proposals are based on an estimated group profit of £3¾ million (before tax) for 1955. This would compare with the previous year's record surplus of £4½ million, and with one of a little over £3 million in 1953. If the estimate is realized, the directors would expect to recommend, next month, a final dividend making for the year a total of between 60 and 70 per cent on the reconstructed ordinary and "A" ordinary capital. Both issues have been quoted lower since the announcement of the proposals, the "A" being now 51s and the ordinary 39s. Assuming a 65 per cent dividend, the latter are on a prospective yield basis of a little over 8 per cent.

in Electrical Investments

Company or Board	Nom. Value	Middle price 2nd Jan.	Three Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	39/-	−1/-	45	70	—	52/6	35/6
I.C.I.	£1	48/-	−1/-	15	10*	4 3 3	61/9	38/3
Intl. Combustion	5/-	18/-		20	25	—	24/6	16/-
Johnson & Phillips	£1	46/3	+1/3	15	15	6 9 8	52/6	39/6
Lancashire Dynamo	£1	47/6		14	15	—	56/5	37/3
Laurence, Scott	5/-	16/9		20	12½*	3 17 0	19/6	14/6
Lister, R. A.	£1	34/9	+4/9	9·3	10	5 15 1	40/-	28/9
London Elec. Wire	£1	52/-	+9d	10	12½	4 16 3	61/3	50/6
Lucas, J.	£1	38/-	−2/-	7½	7½	3 19 0	56/6	38/9
Marryat & Scott	2/-	10/3		25	30	5 17 0	13/-	9/6
Mather & Platt	£1	63/-	+2/6	15	13·4*	—	75/-	48/-
Metal Industries	£1	25/6	−1/9	9	9	7 1 2	38/-	25/-
Midland Elec. Mfg.	£1	48/9	−1/3	15	10*	4 2 0	55/-	44/-
Morphy-Richards	4/-	28/3		35	50	7 1 6	35/-	27/-
Murex	£1	69/6		15	20	5 15 1	67/6	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	3/-		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	8/3		8	14	8 9 9	13/2	7/3
Parsons, C. A.	£1	82/6	−1/-	7½	10	2 8 6	100/-	56/-
Plessey	10/-	85/-	+1/6	20	30†	3 10 6	89/-	55/-
Pye "A" Deferred	5/-	20/9	−2/6	20	12½*	3 0 3	32/9	14/3
Revo	10/-	12/6		9	9	7 4 0	15/6	12/6
Reyrolle	£1	105/-		13¾	15	2 17 2	127/6	89/-
Rheostatic	4/-	12/6	+3d	20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	16/-		15	16¾	5 4 3	19/-	11/-
Scottish Cables	4/-	17/3		27½	27½	6 7 6	22/6	16/3
Smith (England), S.	4/-	13/6	−1/-	17½	17½	5 3 9	20/-	14/9
Southern Areas	£1	30/6		7½	10	6 11 3	38/-	27/6
Strand Elec.	5/-	8/3	−6d	17½	15*	9 1 9	13/3	7/6
Sturtevant	5/-	31/3	+1/9	18·9	14·4*†	2 6 0†	35/9	21/-
Sun Elec.	£1	35/-		15	20	11 8 9	35/-	33/9
Switchgear & Cowans	5/-	17/-		10	20	5 17 9	17/-	11/-
Taylor Tunnicliff	5/-	14/3		12½	15	5 5 3	16/3	11/3
T.C.C.	10/-	43/9		30	25*	5 14 3	53/9	41/-
T.C. & M.	£1	33/6	−1/-	8½	8½	5 1 6	40/9	29/3
Telephone Mfg.	5/-	8/3		10	10	6 1 3	11/6	7/9
Thorn Elec.	5/-	22/6	+6d	20	15*	3 6 8	33/-	13/9
Thornycroft	£1	48/9		15	15*	6 3 0	48/9	34/6
Tube Investments	£1	69/-	+6/6	22½	14*‡	4 1 2	62/6	55/-
Vactric	5/-	18/9		10	15*	4 0 0	22/-	12/-
Veritys	5/-	7/9	−3d	12½	12½	8 1 3	12/2	7/-
Walsall Conduits	4/-	13/6	−6d	70	70	—	17/3	12/-
Ward & Goldstone	5/-	38/3	+9d	50	30*	3 18 6	45/-	32/6
Watford	2/-	7/6	+6d	22½	25	—	8/9	6/3
Westinghouse Brake	£1	97/6	+1/-	16	18	3 13 9	110/-	82/-
West, Allen	5/-	14/-	+6d	17½	15*	5 7 2	16/6	8/-
Wolf Electric	5/-	26/3		17½	20	3 16 3	26/3	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	67½	−2½	6	6	8 18 0	88	67½
Ord.	100	42½	−2½	3¾	3¾	8 16 6	54½	45
Anglo-Portuguese	£1	22/-		8	8	7 5 6	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	18/-	−1/-	50	22½*	6 5 0	24/3	19/-
Cable & Wireless:								
Ord.	£1	43/6	+6d	9	10	4 12 0	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100	92/-
Calcutta Trams	£1	26/9		6†	7½†	5 12 3†	26/9	20/-
Cape Elec. Trams	£1	18/9		5½	7½	8 0 0	19/6	16/6
Marconi Marine	£1	31/3		10	10	6 8 0	41/3	31/3
Oriental Tel. Ord.	1/-	77/6	−2/-	16	—	—	102/6	72/6
Telephone Rentals	5/-	11/9	+3d	10	12½	5 6 6	13/6	9/6

Brook Motors

At the recent annual meeting of Brook Motors, the chairman was able to report a record turnover in the year to September last, and an improvement in profits (before tax) from £424,000 to over the half-million mark. He spoke of a continued upward demand for the products not only from the home market, but also from many countries overseas, and made special mention of the success of sales in America. Net profits, after all charges, represented earnings of 66 per cent on the company's £571,000 ordinary capital, and so covered two-and-a-half times over the increased dividend of 25 per cent. At 45s 6d the 10s ordinary shares stand not much below their peak price, and offer a 5½ per cent yield. Demand for the equipment is stated to be still increasing.

A.E.I. (Australia)

Although there is no official quotation here, a market now exists for the ordinary shares of A.E.I., Ltd. (Australia). Holding formerly the whole of the company's £4 million (Australian) ordinary capital, Associated Electrical Industries (the U.K. company) have made available rather more than a million of the £1 shares to the Australian public. These have been available here lately at around 21s 6d. Given a continuation of earnings at the current level, the chairman of the company has said, a dividend of 7½ per cent may be expected. That rate would be equivalent to 6 per cent in the United Kingdom, and would mean a yield of just over 5½ per cent from the shares. Profits for the latest year may be below the record figure of £543,000 for 1953–54, but at a satisfactory level, and continued expansion of the business is anticipated.

REPORTS and DIVIDENDS

Enfield Rolling Mills, Ltd.—The directors announce that the offer to purchase the issued share capital of the Watliff Co., Ltd., manufacturers of commutators, has been accepted by the holders of more than 90 per cent of the issued capital. The circular states that the total cost of the Watliff purchase, including certain payments of compensation for loss of office, amounts to approximately £400,000. Circular letters, provisional allotment letters and forms of application for excess shares in connection with the issue to ordinary stockholders of Enfield Rolling Mills of 130,000 ordinary shares of £1 each at 62s per share have been posted. An interim dividend of 5 per cent has been paid on £1,425,000 Enfield Rolling Mills ordinary stock and it is anticipated that a final dividend of not less than 15 per cent on the increased ordinary stock will be recommended.

Peto Scott Electrical Instruments, Ltd.—The annual meeting was held on 29th December, Mr. C. F. Hollamby (chairman) presiding. In his circulated statement the chairman reviewed the events since the board was reconstituted in March, 1954, and the subsequent reorganization of the company's capital and structure. He said that on the domestic side sales had expanded, the turnover for the year being 20 per cent in advance of the previous year's. This advance had continued to date and sales on the domestic side to the end of October last had proved a record.

The Morgan Crucible Co., Ltd., has declared an interim dividend of 3¾ per cent on capital increased from £2,459,960 to £4,304,930 by a three-for-four scrip issue. This compares with an interim dividend last year of 6 per cent on the smaller capital.

W. H. Allen, Sons & Co., Ltd., have announced an interim dividend of 5 per cent (unchanged).

New Companies

International Combustion (Nuclear Applications), Ltd.—Registered 19th December. Capital £100. To undertake scientific research of any kind in any part of the world, including research work in connection with the generation of power by nuclear fission, etc. Regd. office: 19, Woburn Place, W.C.1.

John Nicholas, Ltd.—Registered 20th December. Capital £1,000. Electrical engineers and contractors, etc. Directors: W. B. Nicholas and T. T. O'Driscoll. Regd. office: Brunel, 20, Western Avenue, Newport, Mon.

Monteith Electrical Co., Ltd.—Registered 8th December. Capital £4,000. To acquire the business of electrical engineers and contractors carried on by R. C. Monteith at Histon, etc. Directors: R. C. Monteith and L. A. Stearn. Secretary: Mrs. Doris Monteith. Regd. office: 97, Station Road, Histon, Cambs.

Electric Washers (Northern), Ltd.—Registered 7th December. Capital £500. Manufacturers of and dealers in electric washing machines and electrical appliances, etc. Directors: A. L. Hopton, Florence Hopton (secretary) and G. E. Whitworth. Regd. office: 16, King Charles Street, Leeds.

Electro-Vac (Ashbourne), Ltd.—Registered 7th December. Capital £1,000. Manufacturers of and dealers in television tubes, radio and television sets, etc. Directors: E. A. Higton and three others. Regd. office: Belle View Works, Belle View Road, Ashbourne, Derbyshire.

Ryhope Electrix, Ltd.—Registered 10th December. Capital £100. To acquire the business of an electrical contractor carried on by C. M. Marks at Sunderland, etc. Directors: A. A. Gordon, M. B. Davidson and R. L. Anderson. Regd. office: 77, Ryhope Street South, Ryhope, co. Durham.

Martin's (Eltham), Ltd.—Registered 10th December. Capital £100. Radio, television, electrical and electronic engineers, etc. Directors: R. H. J. Martin, P. G. Martin and Mrs. Ivy M. Martin. Regd. office: 131a, Eltham High Street, S.E.9.

Frank Mozer, Ltd.—Registered 9th December. Capital £1,000. Manufacturers, repairers, servicers and hirers out of and wholesale and retail dealers in radio, electrical and mechanical apparatus of all kinds, etc. Directors: F. Mozer and A. Mozer. Regd. office: 5, Angel Corner Parade, Edmonton, N.18.

W. S. Electronics (Extruders), Ltd.—Registered 5th November. Capital £100. Manufacturers of extruding machines, machinery of all types, manufacturers of machine tools, files, etc. The first directors are to be appointed by the subscribers. Regd. office: 34-36, Brunel Road, W.3.

S.E.C. Products, Ltd.—Registered 3rd December. Capital £1,000. Manufacturers of and dealers in electrical and mechanical apparatus and accessories, etc. Directors: J. T. Holmes and P. A. Young. Regd. office: 53, Sheep Street, Northampton.

Machine Tools (Northampton), Ltd.—Registered 14th December. Capital £1,000. Manufacturers of and dealers in electrical and mechanical apparatus and accessories, etc. Directors: J. T. Holmes and F. B. C. Chance. Regd. office: 53, Sheep Street, Northampton.

Elon Tape Development Co., Ltd.—Registered 15th December. Capital £500. Manufacturers and repairers of electric tape recorders, electronic recorders, television sets, etc. The first directors are to be appointed by the subscribers. Solicitors: Swepstone Walsh & Son, 3, Pump Court, Temple, E.C.4.

Sound Television (London), Ltd.—Registered 13th December. Capital £100. Hirers, letters out on hire, buyers, sellers and manufacturers of and dealers in electrical apparatus and equipment, radio and television apparatus, etc. Regd. office: Triumph House, 189, Regent Street, W.1.

Bankruptcies

J. E. Rippin, Egglestones Yard, Sherwood Avenue, Newark-on-Trent, electrical engineer.—Public examination 2nd February at the County Court House, St. Peter's Gate, Nottingham.

J. Hiller, electrical and radio dealer, 76, Whitechapel Road, London, E.1.—Application for discharge withdrawn.

J. F. Husband, 22, Mettham Street, Lenton, Notts, electrical trade contractor.—Trustee, Mr. E. C. Stimpson, 27, Regent Street, Park Row, Nottingham, Official Receiver, released 16th December.

Liquidation

G. Ellam, Ltd.—Winding up voluntarily. Liquidator, Mr. N. B. Oakes, 38, Market Street, Whaley Bridge, Stockport, Cheshire, appointed 7th December.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 21st January:—

TRIANGLE (design). No. 737,671, Class 7. Electric welding machines and machines for removing carbon deposit from internal combustion engines; and parts of all such machines. TRIANGLE (design). No. 737,672, Class 9. Electric welding apparatus and parts; goggles, protective masks, protective helmets, gloves for protection against accidents, welding electrodes, electric condensers; and graduated instruments for marking-out shapes on flat surfaces.—Triangle Products, Ltd., Greencroft Mill, Manchester Road, Hyde, Manchester.

PRESCOLLAN. No. 744,933, Class 7. Metal working machines, textile machines, pumps, electric motors (not for land vehicles), electric generators, machine tools, machine couplings, mechanisms for operating machinery by direct or remote control, machines for mechanical handling and parts.—Precision Rubbers, Ltd., Bagworth, Leics.

HALLFORD. No. B745,532, Class 7. Escalators and lifts and parts.—J. & E. Hall, Ltd., 10, St. Swithin's Lane, London, E.C.4.

ELFIN. No. 746,527, Class 7. Washing machines and parts. ELFIN. No. 746,528, Class 9. Electric vacuum cleaners and parts.—The British Vacuum Cleaner & Engineering Co., Ltd., Goblin Works, Ermyn Way, Leatherhead, Surrey.

AGATOMIC. No. 746,022, Class 9. Indicating instruments for use in the control of heat; electric kitchen utensils; electric flat irons; electric percolators; automatic temperature regulators; thermostats; and parts.—Aga Heat, Ltd., Orchard House, 30, Orchard Street, London, W.1.

DIALECTRIC. No. 746,709, Class 12. Electrically powered fork lift trucks. DIAMATIC. No. 746,710, Class 12. Power-operated fork lift trucks.—Diac, Ltd., Vulcan Way, King Henry's Drive, New Addington, Croydon, Surrey.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Basildon.—U.D.C. Street lighting equipment. (See this issue.)

Bath.—14th January. City Council. Starter batteries (Schedule 34), low-voltage electric cables (38), electric discharge lamps, control gear and fittings (39), tungsten lamps and electrical fittings (40), lanterns for street lighting (groups A and B, Schedules 42 and 43), time switches for street lighting (44), for year ending 31st March, 1957. City and waterworks engineer, Guildhall.

Belfast.—27th January. Electricity Department. Fire extinguishing equipments and electrical stores. (See this issue.)

Biggar (Lanark).—Corporation. Trunk road lighting equipment. (See this issue.)

Dover.—26th January. R.D.C. Trunk road lighting equipment. (See this issue.)

Dronfield.—28th January. U.D.C. Street lighting equipment. (See this issue.)

Dublin.—18th January. Eire Commissioners of Public Works. Electrical installation at Muinebeag Presentation Convent National School, Co. Carlow. J. Tyrrell, Secretary, Office of Public Works.

Fareham.—27th January. U.D.C. Trunk road lighting equipment. (See this issue.)

Formosa.—20th January. Central Trust of China, Taipei. One 55,000 kVA transformer and spare parts. (E.S.B. 27728/55. Ten/17232.)*

Hackney.—25th January. Borough Council. Materials including electric lamps for street lighting for one year from 1st April next. (See this issue.)

Havant and Waterloo.—21st January. U.D.C. Electric cables and fittings for the year ending 31st March, 1957. Surveyor, 1, Park Road North, Havant.

Hoddesdon.—20th January. U.D.C. Trunk road lighting equipment. (See this issue.)

India.—17th January. Hydel Commercial-cum-Distribution Circle, Bareilly. Two 6·6/33 kV, 1,250 kVA and two 33/11 kV, 1,250 kVA power transformers. (E.S.B. 27853/55. Ten/17251.)*

18th January. Government of Travancore-Cochin Stores Purchase Committee, Trivandrum. 11 kV insulators and fittings. (E.S.B. 28269/55. Ten/17310.)*

23rd January. Government of Andhra Electricity Department, Madras. 11 kV indoor control and metering cubicles, oil switches, tripping units and alarm bells. (E.S.B. 28281/55. Ten/17311.)*

Lanark.—28th January. County Council. Trunk road lighting equipment. (See this issue.)

Morley.—18th January. Corporation. Street lighting equipment. (See this issue.)

Navan.—12th January. Meath County Council. Electrical services at the fire station. The Secretary, Meath County Council, County Hall.

New Zealand.—31st January. Director-General, Stores Division, G.P.O., Wellington. Radio transmitters and receivers. (E.S.B. 27651/55. Ten/17228.)* 9th February. Alarm, resistance and switchboard lamps. (E.S.B. 28053/55. Ten/17294.)* 13th February. Power transformers, filter chokes, and audio frequency transformers. (E.S.B. 28052/55. Ten/17278.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Norton.—30th January. U.D.C. Trunk road lighting equipment. (See this issue.)

Prestwich.—30th January. Borough Council. Electric lamps (Form 13) and electrical equipment (Form 14), during the year ending 31st March, 1957. Borough surveyor, Town Hall.

Rhodesia and Nyasaland.—20th January. Federal Tender Board, Causeway. Electric lamps, bayonet type. (E.S.B. 27835/55. Ten/17242.)*

South Africa.—17th January. Stores and Buying Branch, City Treasurer's Department, Johannesburg. Copper conductor. (E.S.B. 27886/55. Ten/17234.)*

13th January. Stores Department, South African Railways, Johannesburg. Telegraph line material. (E.S.B. 27570/55. Ten/17235.)* 18th January. Lead acid storage cells. (E.S.B. 27894/55. Ten/17261.)* 10th February. Battery operated crane truck and charging unit. (E.S.B. 27880/55. Ten/17268.)*

2nd February. Union Tender and Supplies Board, Pretoria. 33 lighting sets. (E.S.B. 28100/55. Ten/17274.)* Telephone bridle wire. (E.S.B. 28098/55. Ten/17284.)* Circuit-breakers. (E.S.B. 28099/55. Ten/17283.)* V.h.f. radio equipment. (E.S.B. 28131/55. Ten/17273.)*

Stockton.—Corporation. Electrical installations in 27 houses being built on the Newtown estate. T. C. Hartley, borough architect, 28, The Square.

Swansea.—28th January. Corporation. Electric cable (street lighting), electric lamps and public lighting equipment for one year to 31st March, 1957. Borough surveyor, Guildhall.

Thurrock.—23rd January. U.D.C. Columns and electrical equipment for 133 sodium and eight fluorescent Group "A" street lighting units and 41 Group "B" units, Scheme 4. Council Offices, Whitehall Lane, Grays, Essex.

United States.—19th January. Bureau of Reclamation, Denver, Colorado. Line control and generator voltage switchgear assembly for Deer Creek power plant, Provo River project, Utah. (E.S.B. 27718/55. Ten/17313.)*

Wigan.—13th February. Street lighting equipment. (See this issue.)

ORDERS PLACED

Carlisle.—Corporation Housing Development Committee. Accepted. Electrical installations in 108 houses at Morton (£2,647), 42 aged persons' bungalows at Morton (£1,002), and 12 flats at Newtown Road (£295).—Hartley Electromotives, Ltd.

Redcar.—Corporation. Accepted. Installation of street lighting from Broadway to the Coast Road (£16,248).—North Midlands Engineering Co.

Rushden.—U.D.C. Lighting of trunk road (£5,534).—North Midlands Engineering Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Airedale.—Crematorium, Rawdon; F. L. Charlton, architect, 21, Bond Street, Leeds, 1.

Ashton-under-Lyne.—Flats and maisonnettes (134), Charlestown; borough surveyor.

Bexley.—Mechanical and electrical services for second phase of grammar school, and erection of shops on the Lodge Hill estate; borough surveyor, Council Offices, Bexleyheath, Kent.

Billingham-on-Tees.—Research block at Empire Works; Davy and United Roll Foundry, Ltd., Haverton Hill-on-Tees.

Birkenhead.—Eight-storey office block, New Chester Road; Cammell, Laird & Co., Ltd., The Docks.

Birmingham.—Office block and warehouse at Stour Street, for H. Sumner, Ltd.; D. K. McGowan, architect, 29, Gower Street, Birmingham.

Blackpool.—Houses (114), Beryl Avenue area; Sir Lindsay Parkinson & Co., Ltd., 171, Shaftesbury Avenue, London, W.C.2.

Bootle.—Dwellings, Netherton estate: City Contractors, Ltd., 40, North John Street, Liverpool (43) and Fairclough & Foster, Ltd., 4, Aintree Road, Liverpool (25).

Bracknell.—Shopping centre, the Broadway (about 70 shops), for Development Corporation; general manager, Farley Hall, Binfield, Bracknell, Berks.

Bradford.—Works development scheme, including two-storey offices, large warehouse, etc.; Hepworth & Grandage, Ltd., engineers, St. John's Works.

Brigg (Lincs).—Gregory-type housing units at Kirton Lindsey (£60,991) and 14 houses on Magna Charta site (£18,968); R.D.C. architect.

Brighton.—Flats (28), Lower Bevendean estate (£58,100); borough engineer and surveyor, 26-30, King's Road.

Houses (62), North Woodingdean; Knight Bros. (Brighton), Ltd., 19, Bristol Gardens.

Bristol.—Development of estate at Bath Road, Longwell Green, for about 300 houses; George Wimpey & Co., Ltd., developers, Hammersmith Grove, London, W.6.

Burnley.—Houses (74), Far Brunshaw estate; Middleton & Co. (Blackpool), Ltd., Bank Street Sidings, Blackpool.

Chelmsford.—Crematorium, Writtle Road Cemetery; borough engineer.

Cheltenham.—Flats (46), Princess Elizabeth Way; borough surveyor.

Coventry.—Central bus station with canteen, offices, stores, etc.; city architect, Bull Yard.

Extensions at the Coventry and Warwickshire Hospital for Birmingham Regional Hospital Board; A. Matts & Son, Ltd., Vecqueray Street, Coventry.

Branch library, Willenhall area; A. H. Gardner & Partners, architects, 11, Eaton Road.

Croydon.—Large factory at Purley Way (about £100,000); Robin Seifert, architect, 28, Great Ormond Street, London, W.C.1.

Eastbourne.—Houses (41), Willingdon Road; A. G. V. Avon, Ltd., builders, 8, Stoke Abbott Road, Worthing.

Ambulance station, Dursley Road; J. G. Robinson & Son, Ltd., 6, Cornfield Terrace.

Edinburgh.—Six-storey business premises; C. & A. Modes, Ltd., 505, Oxford Street, London, W.1.

Felling (Co. Durham).—Dwellings (180), including flats and maisonnettes, Wellington Street re-development area; R. Morton, chief housing officer.

Goole.—Factory on 14-acre site on Rawcliffe Road industrial estate; British Belting & Asbestos, Ltd., Scandinavia Mills, Cleckheaton.

Heckmondwike.—Houses (50), Dale Lane estate; clerk to the U.D.C., 6, Church Street.

Jarrow.—Factory on Bede trading estate; Fry's Diecastings, Ltd., Prince George's Road, London, S.W.19.

Lanarkshire.—Houses (96), Bellshill; S. McColl, county architect, Beckford Street, Hamilton.

Lincolnshire.—Three-form entry secondary modern school, Holbeach, and four-form entry secondary modern school, Long Sutton; Architects' Co-Partnership, 44, Charlotte Street, London, W.1.

Liverpool.—Works, Kirkby trading estate; Davies & Bennett, Ltd., 34/8, Chatham Street.

London.—Institutes of Archæology and Classical Studies, Gordon Square, Bloomsbury; Booth & Ledeboer, architects, 14, Lincoln's Inn Fields, W.C.2.

Chest clinic, St. Giles' Hospital, Camberwell; Couzens & Brown, consulting engineers, 9, Old Queen Street, S.W.1.

Office block, Pall Mall, Westminster; F. G. Minter, Ltd., 4, Buckingham Gate, S.W.1.

Shops (25), with dwellings over, at Finchley Road, Swiss Cottage; Norman & Dawbarn, architects, 5, Gower Street, W.C.1.

Extensions to Royal Masonic Hospital, Ravenscourt Park, W.6; Sir John Burnet, Tait & Partners, architects, 10, Bedford Square, London, W.C.1.

Manchester.—Cinema, Wythenshawe Civic Centre; J. Arthur Rank Organization, Belgrave Road, London, S.W.1.

Office block, Princess Street and Mosley Street; city architect.

Morden.—Additional factory; F. A. Norris & Co., Ltd., Garth Road.

Newcastle-on-Tyne.—Factory and offices, Boyd Street, for Gill and Nicholson, Ltd., builders, Saville Row.

Additions to Bolam Street Secondary Modern School and North Fawdon Primary School; city architect (Education Department), Northumberland Road.

Rebuilding Rock Hotel, Cambridge Street, for J. Reid and Son; Hadden and Hillman, Ltd., builders, 127 New Bridge Street.

Factory additions, Back Chapman Street, for the Metal Box Co., Ltd.; Stephen Easten, Ltd., builders, Westgate Road.

Houses (380), Kenton North; city architect, 18, Cloth Market.

Newport (I.O.W.).—Grammar technical school; county architect, County Hall, Newport.

North Riding.—Fire station, Guisborough (£11,500), and old people's home, Richmond (£49,000); county architect, County Hall, Northallerton.

North Shields.—Industrial developments on the Chirton estate for Blackwood Hodge, Ltd., Northampton; R. Fielding, architect, Aldwych House, Aldwych, London, W.C.2.

Norwich.—Dwellings (100), with an additional 200 at a later date; H. C. Rowley, city engineer, City Hall.

Penlan (Brecon).—Secondary grammar/technical boys' school: C. M. S. Wells, clerk of C.C., County Hall, Brecon.

Portsmouth.—Offices for Hampshire Building Society; Frank J. Privett, Ltd., builders, Copnor Road.

Bank premises with offices and dwellings over, 44/46, Elm Grove; Lloyds Bank, Ltd., 71, Lombard Street, London, E.C.4.

Reading.—Factory, off Cow Lane; Mideastra, Ltd., Cardiff Road.

Westwood Secondary School for Girls; Boyd & Murley, Ltd., builders, 87, London Street.

Redcar.—Houses (190), Green Lane site; K. W. Ash, borough engineer.

Romford.—Dwellings (128), Lodge Lane; borough surveyor.

Rotherham.—Estate shopping centre, Kimberworth Park (£70,660); E. J. Manson, borough surveyor, Municipal Offices.

Royton.—Extensions to the Town Hall; U.D.C. surveyor.

Runcorn.—Aged persons' bungalows (32) and warden's hostel, Queens Road; U.D.C. surveyor.

Scarborough.—Methodist church and hall, Wreyfield Drive: W. Blanchard, architect, 29, George Street, Hull.

Southampton.—St. George's R.C. School; A. F. Myers & Partners, electrical consultants, 147, Victoria Street, London, S.W.1.

Staverton.—Extension of terminal building at Airport; city architect, Suffolk Street, Gloucester.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 8th February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

8220. Standard Telephones & Cables, Ltd.—Electric power supply systems. 1st April, 1952. (744401.)

12060. Standard Telephones & Cables, Ltd.—Intelligence storage equipment. 21st May, 1952. (744352.)

27548. General Electric Co., Ltd., and Cashmore, P. J.—Bobbins and winding assemblies for electric transformers and the like. 24th November, 1952. (744463.)

1952

8197. Marconi's Wireless Telegraph Co., Ltd., and Buckingham, J.—Electrical converting circuit arrangements. 25th November, 1952. (744526.)

12816. Standard Telephones & Cables, Ltd.—Electric circuits for combining items of intelligence. 21st May, 1952. (744356.) 12817. Electric register and signalling equipment. 21st May, 1952. (744357.) 12818. Telephone subscriber's metering equipment. 21st May, 1952. (744358.)

15430. Parsons & Co., Ltd., C. A.—Heat exchangers. 4th June, 1953. (744404.)

21140. English Electric Co., Ltd.—Radio frequency induction heating. 21st August, 1953. (744601.)

24692. Cinema-Television, Ltd.—Electronic counting of objects. 2nd October, 1953. (744470.)

25503. Siemens & Halske Akt.-Ges.—Housing of electrical components. 10th October, 1952. (744528.)

27343. General Electric Co., Ltd.—Self-balancing electric bridge apparatus. 29th January, 1954. (744364.)

27999. Metropolitan-Vickers Electrical Co., Ltd.—A.c. electric meters. 30th October, 1953. (744529.)

28804. British Thomson-Houston Co., Ltd.—Electromagnetic switches. 2nd November, 1953. (744474.)

29388. Parsons & Co., Ltd., C. A.—Recuperative heat exchangers. 20th November, 1952. (744407.)

29964. Reyrolle & Co., Ltd., A.—Electric control systems. 26th November, 1953. (744367.)

31601. Pullars Instruments, Ltd.—Clockwork controlled electric switch mechanism. 6th January, 1954. (744371.)

32323. Bird Electronic Corporation.—Electrical voltage and/or current indicator for high frequency coaxial lines. 19th December, 1952. (744479.)

32995. Pirelli Soc. per Azionii.—High tension electric cables. 30th December, 1952. (744481.)

1953

1828. Bühler, A., and Bühler, R. (trading as Bühler, Geb.)—Electrical drives for coupled four-roller mills. 21st January, 1953. (744611.)

2210. Horstmann Gear Co., Ltd.—Time switches and the like. 26th January, 1954. (744612.)

4012. General Electric Co., Ltd., and Franklin, D. C.—Methods of manufacturing metal articles. 10th February, 1954. (744374.)

5896. General Electric Co., Ltd., and Lambert, R. A.—Auto-transformers. 8th April, 1954. (744485.)

6339. Wipac Development, Ltd., and Gayler, G. A.—Rotary electrical switches. 22nd February, 1954. (744486.)

6571. Igranic Electric Co., Ltd.—Electric motor controllers. 10th March, 1953. (744537.)

7014. Kelvin & Hughes, Ltd.—Electrical interrupters. 4th March, 1954. (744617.)

7483. Svenska Aktiebolaget Gasaccumulator.—Radio receivers for co-operation with certain radio beacons to provide an indication of distance. 18th March, 1953. (744619.)

10437. General Electric Co., Ltd., and Fitzpatrick, J. A.—Electric protective arrangements. 14th April, 1954. (744542.)

11096. British Broadcasting Corporation.—Electric switching apparatus. 21st July, 1954. (744419.)

12665. Elliott Bros. (London), Ltd.—Terminations for high frequency waveguides and coaxial lines. 6th May, 1954. (744494.)

13760. Naylor, W. E.—Cleats for electric conductors. 7th September, 1953. (744495.)

14734. Lucas (Industries), Ltd., J.—Rotary electric switches. 12th May, 1954. (744629.)

15006. English Electric Co., Ltd.—Servo-mechanical control systems. 28th May, 1954. (744630.)

17956. General Electric Co.—Electrical insulating materials. 29th June, 1953. (744500.)

18029. Decca Record Co., Ltd.—Radar display systems. 29th June, 1954. (744640.)

18284. Diamond H Switches, Ltd.—Electrical switches or other electrical regulating devices having pilot lights. 23rd June, 1954. (744501.)

19647. British Thomson-Houston Co., Ltd.—Methods of and apparatus for manufacturing reflector lamp bulbs. 15th July, 1953. (744642.)

19802. Landis & Gyr Akt.-Ges.—Totalizing counter mechanism for a maximum demand electricity meter. 16th July, 1953. (744503.)

21746. Tesla, Narodni Podnik.—Safety electric discharge lamp. 6th August, 1953. (744387.)

22225. Babcock & Wilcox, Ltd.—Mechanical stokers. 11th August, 1954. (744508.)

24508. Philips Electrical Industries, Ltd.—Magnetic electron lenses and pole pieces for use therein. 4th September, 1953. (744647.)

24994. Radio Corporation of America.—Line structure elimination in cathode-ray tubes. 9th September, 1953. (744648.)

25182. Standard Telephones & Cables, Ltd.—Electric signal amplifiers. 3rd September, 1954. (744555.)

27252. Philips Electrical Industries, Ltd.—Methods of and apparatus for measuring the intensity of X-ray radiation. 5th October, 1953. (744397.)

29213. Pirelli-General Cable Works, Ltd., and Arman, A. N.—Corrugated metal pipes. 12th August, 1954. (744435.)

29587. Radio Corporation of America.—Stabilized signal amplifier embodying semiconductor devices. 26th October, 1953. (744436.)

31647. S.U. Carburetter Co., Ltd.—Electrically operated pumps. 29th October, 1954. (744443.)

34491. Philips Electrical Industries, Ltd.—Circuits for measuring small direct voltages. 10th December, 1953. (744574.)

1954

21248. Standard Telephones & Cables, Ltd.—Electrical number converting equipment. 21st May, 1952. (744400.)

1955

9160. Metropolitan-Vickers Co., Ltd.—A.c. electric meters. 30th October, 1953. (744590.)

21268. Standard Telephones & Cables, Ltd.—Electrical vibrators. 1st April, 1952. (744460.)